

Radio in 1930—Sub-Sea Salvaging—Giant Planes
Ancient Man In Europe—Television

SCIENTIFIC AMERICAN

December 1929



35¢ a Copy



Science Restores the Cave Man



LET ENGINEERING FACTS DECIDE YOUR TRUCK CHOICE!

You need never drive a Dodge Truck to prove how good it is. You need never see it, in fact. You can determine the soundness of its design, its advanced construction and its fitness for your needs on the basis of engineering facts alone.

Check the specifications of a Dodge Truck. Give special heed to the motor refinements—those features that so obviously contribute to its economy, smoothness, power, speed, ruggedness and long life.

Consider the axles in terms of metal, bearings and design. Check well the specifications on cooling system, universal joints, transmission and steering gear.

After making a part-by-part analysis of a Dodge Truck you will conclude—as thousands of other mechanically-minded truck buyers have concluded—that there is no need to seek additional proof. The facts disclosed by engineering details tell the true story about Dodge Trucks.

Drive one, too, if you wish—any time, any type. Either way your selection will be a wise one—your investment a profitable one.

1½-TON—109" wheelbase (4-cyl.) . . .	\$ 525
¾-TON—124" wheelbase (4-cyl.) . . .	675
¾-TON—124" wheelbase (6-cyl.) . . .	775
1-TON—133" wheelbase (4-cyl.) . . .	745
1-TON—133" wheelbase (6-cyl.) . . .	845
1-TON—140" wheelbase (6-cyl.) . . .	
Heavy Duty	1065
1½-TON—150" wheelbase (6-cyl.) . . .	1345
1½-TON—165" wheelbase (6-cyl.) . . .	1415
2-TON—150" wheelbase (6-cyl.) . . .	1515
2-TON—165" wheelbase (6-cyl.) . . .	1585
3-TON—135" wheelbase (6-cyl.) . . .	1745
3-TON—165" wheelbase (6-cyl.) . . .	1775
3-TON—185" wheelbase (6-cyl.) . . .	1845

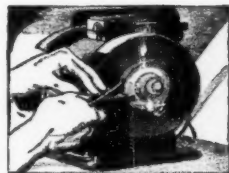
Chassis prices f. o. b. Detroit

DODGE TRUCKS



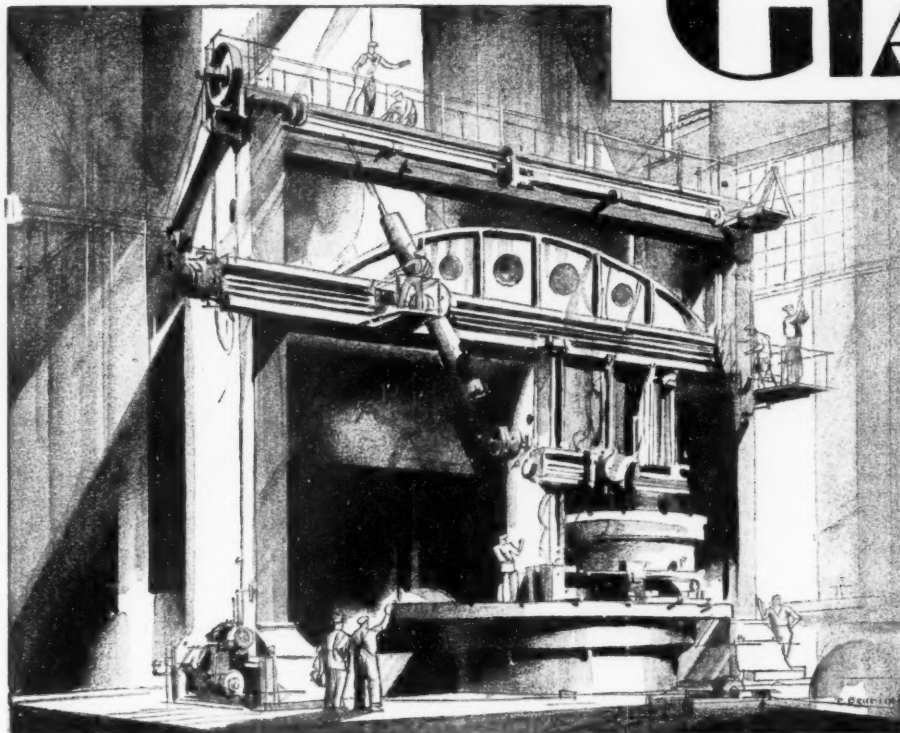
CHRYSLER MOTORS PRODUCT

From pygmies



to

GIANTS



Giant Vertical Boring and Turning Mill built by William Sellers & Co. of Philadelphia, Pa. ...equipped with SKF Anti-Friction Bearings.

At top: A small tool grinder that is also SKF-equipped.

GOOD PERFORMANCE demands "The Highest Priced Bearing in the World"

THAT'S the thing upon which to base your choice of a bearing.....**PERFORMANCE**.....nothing else in all the world counts.....least of all **PRICE**!

For there's many a man who has bought a cheap bearing at a bargain. But try and find the man who ever got a bargain out of **USING** one.

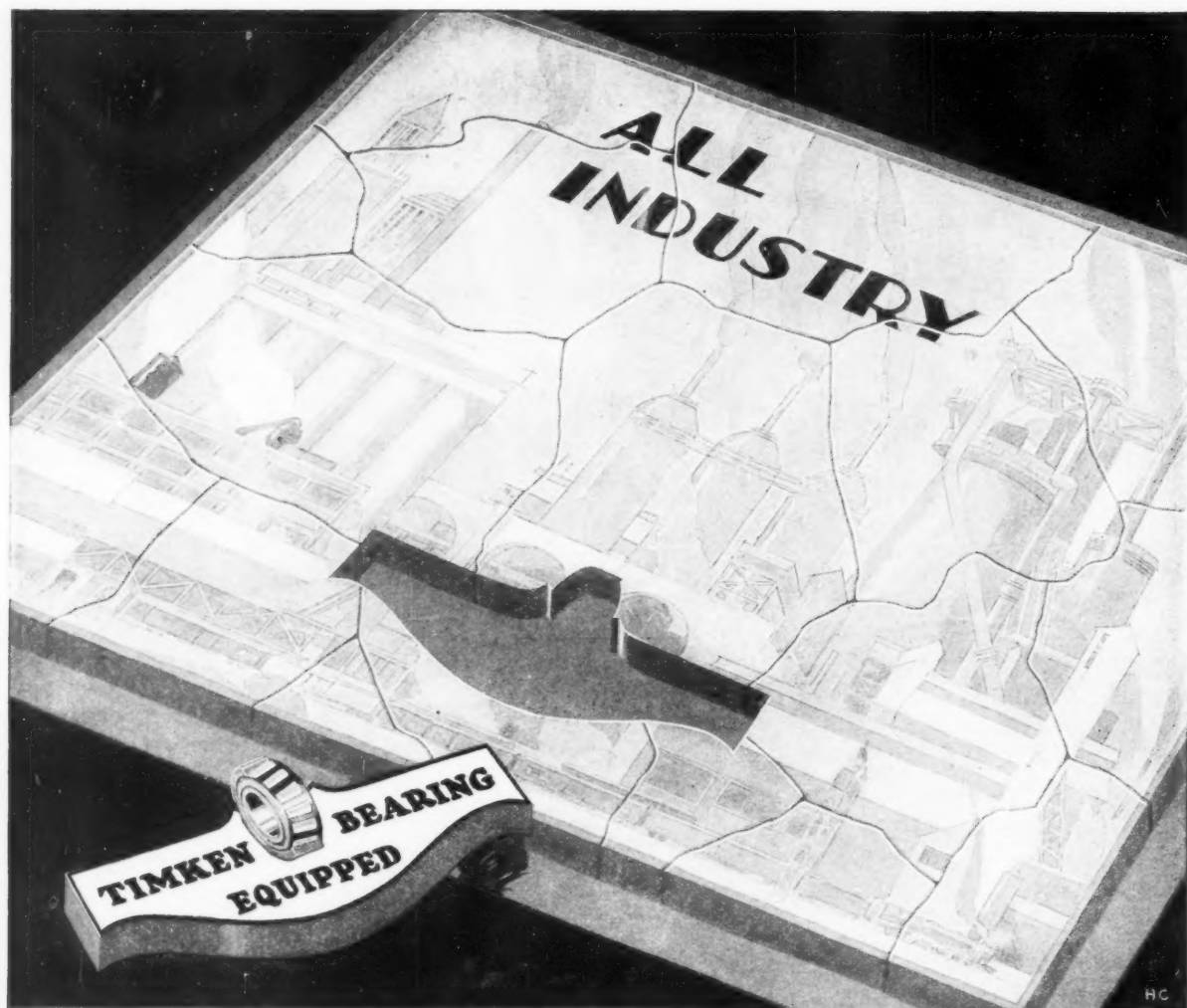
It costs more to produce **SKF** Anti-Friction Bearings...more for the special steels that go into them...more for the precision manufacturing that produces them. But it costs less—**FAR** less—to use them.

SKF INDUSTRIES, INC., 40 East 34th St., New York, N. Y.

143 machine
tool manu-
facturers use
SKF
Anti-Friction
Bearings

SKF

The Highest Priced Bearing in the World



Solving the Production Puzzle

What puzzles Industry most is Waste. The moment "Timken Bearing Equipped" is placed into the picture . . . the bearing problem is solved.

Timken fits into modern production plans as only Timken can. For Timken is *the one bearing that does all things well*. Let the load be all radial, or all thrust, or both in combination . . . let the burden be heavy . . . the pace killing . . . Timken compact, self-contained carrying ability will suit itself to the situation and *carry on*.

Waste meets its Waterloo; friction loses its grip; lubricant becomes a matter of little or no consequence; machinery stays young; costs catapult downward; profits soar skyward.

Industry has placed Timken Bearings on jobs thought impossible. Timken has made them profitable. So today old methods give way before Timken, replacing obsolete machines with machines that are "Timken Bearing Equipped" . . . meeting and mastering the mighty march of modern Industry.

The exclusive Timken combination of Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel is summed up in "Timken Bearing Equipped"—universal symbol for designing and buying machinery that serves, saves and endures *wherever wheels and shafts turn*.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered* Roller BEARINGS

SCIENTIFIC AMERICAN

24 WEST 40th STREET

NEW YORK CITY

December 1929

Edited by ORSON D. MUNN

Eighty-fifth Year

IN THIS ISSUE

Looking Ahead With the Editor.....	469
Among Our Contributors.....	469
Back of Frontispiece—C. Leonard Woolley.....	471
Frontispiece—Mousterian Man, Woman, and Child.....	472
A Scuttled Fleet Is Salvaged—By David Masters.....	473
A Man Without Salvage Experience Raises the German Fleet	
Our Point of View—Editorials.....	477
Lindbergh: Scientist; Fatal Accidents; "White Pants" Workers; Fur-Farming Misconceptions	
When Reindeer Roamed the Pyrenees—By Ida Treat, Ph.D.....	478
France, "Capital of the Prehistoric World," In Cave Man Days	
From the Scrap-book of Science.....	482
Camera Shots of Scientific Subjects	
An Office Building of the New Era—By Stratford Corbett.....	484
Science Contributes to Efficiency, Comfort, and Convenience	
Television's Progress—By A. P. Peck.....	487
What Has Been Done and What We May Expect in the Future	
Giant Airplanes—By Reginald M. Cleveland.....	488
In Which Is Foreseen a New Era in Heavier-than-Air Flying	
Award of the Scientific American Medal.....	491
An Awakened Interest in Sea Safety Has Brought Results	
Behind the Scenes in Modern Archeology—By Horace H. F. Jayne.....	492
Restoration for Exhibition of Field Discoveries	
Timing the Schneider Cup Races.....	495
Recording the Speed of Planes Racing at Over 300 Miles Per Hour	
The Puzzles of the Comets—II—By Henry Norris Russell, Ph.D.....	496
The Sun Picked Up Its Family of Comets Only Recently	
Radio in 1930—By Howard T. Cervantes.....	498
The Final Test of a Set Is Its Tone Quality	
Largest Electrified Metal Mine.....	501
"Strip" Copper Mine Adds Electric Locomotives	
From the Archeologist's Note Book.....	502
Scythian Bronzes; Primitive Art and Food; "False Pyramid"; Early Man in North Arabia; Marble Sculptures and U-V Ray	
Insuring Safety on Airlines—By Lester D. Seymour.....	504
Behind the Pilot Is a Far-reaching Organization	
The Art of Pliocene Man—By J. Reid Moir.....	508
New Discoveries Indicate That Ancient Man Was Highly Intelligent	
Esthetic Engineering—By C. W. Geiger and Ruth Sabichi.....	510
Beautiful Boulevard Is Built by Anchoring Shifting Sands	
When the Dining-Car Staff Goes to School.....	513
Personal Instruction of Waiters and Cooks Is Necessary	
American Passenger Air Transport—III— By Prof. Alexander Klemin.....	514
Further Pertinent Facts Concerning Engines, Pilots, Et Cetera	
Wires and Cables for a Great Bridge—By A. E. Cripps.....	518
Manufacture of Wires for the Cables of the Hudson River Bridge	
Rebuilding a Broken Business—By Milton Wright.....	521
A Huge Candy Industry Developed Through Research	
Scientific American Digest.....	524
Mammoth's Deformed Tooth.....	524
Mechanical Respirator.....	524
Snow-shed Fire Fighters.....	524
Pecan Oil From Wastes.....	525
Dried Hog Stomach New, Cheaper	
Anemia Remedy.....	525
Semi-automatic Army Rifles (Illustration).....	526

Arc-welded Steel Boats.....	526
Fire Lookout On Tall Tree.....	526
Spiral Approach to Bridge (Illustra- tion).....	527
Educational Street Car.....	527
Light Uses Third of Electricity.....	527
Chemistry Helped Graf Zeppelin.....	527
Golf Ball Murders Fish.....	543
Burn Aluminum Dust for Intense Flame.....	543
Cave Man's Brain Found.....	544
Prehistoric Indian Dentists.....	544

Learning to Use Our Wings.....	528
Radio Altimeter.....	528
Instruction in Fog Flying.....	528
Airway Marking.....	528
Slots and Interceptors.....	529
Selling the Light Airplane.....	529

Chemistry In Industry.....	530
Synthetic Resin for Lacquers.....	530
Powdered Fuels for Engines.....	530
Industrial Stills of Glass.....	530
Standardized Weighting Practice.....	530
Everything for Medicine Chest (Il- lustrations).....	532
Ethanalamine Soap Uses.....	534
Carbon Dioxide Gas for Fighting Fires.....	534
Fish Fussy About Salt.....	534
Making Citric Acid.....	545
Rust Used in New Paint Base.....	545
Binding Fixed Nitrogen.....	546
Thickness of Electro-plating.....	546
Ferrie Chloride, Cheap Coagulant.....	546
Lignite Absorbs Sulfur Gases.....	547
New Material for Crucibles.....	547

The Month in Medical Science.....	536
Liver and Iron in Anemia.....	536
Eye Examinations for Children.....	536
Ringworm of the Feet.....	536
Nervous Baldness.....	537
Garage Deaths.....	537

Current Bulletin Briefs.....	538
------------------------------	-----

The Amateur Astronomer.....	540
-----------------------------	-----

The Heavens in December.....	542
------------------------------	-----

Commercial Property News.....	552
-------------------------------	-----

Reward Awaits Inventor.....	552
Cleaning Neon Tubes.....	552
Patent Protection Effective.....	552
Word Writing Machine Perfected.....	553
Misplaced Copyright Notice.....	553
Copyright for Photographs.....	554
Method for Improving Celery.....	554
Insulating Material Patented.....	554
Trademarks for Grapes Invalid.....	554

Patents Recently Issued.....	553
------------------------------	-----

Index to Volume 141.....	557
--------------------------	-----

COVER

Our cover picture this month represents the scientific restoration of a Neandertal man and his family, as described on page 472. The painting, by our artist Howard V. Brown, was made from a copyrighted photograph of the group in the Field Museum of Natural History in Chicago, which was recently placed on exhibition. The colors are not vivid but as far as present knowledge is concerned, they are scientifically accurate.

for EXECUTIVES who use manpower

HERE is a book that will strengthen your control—and double the efficiency of each man working under you. One idea in this book cost an executive \$4,679 and solved a problem which saved his firm over \$55,000 a year thereafter. The book is crammed full of ideas just as valuable.

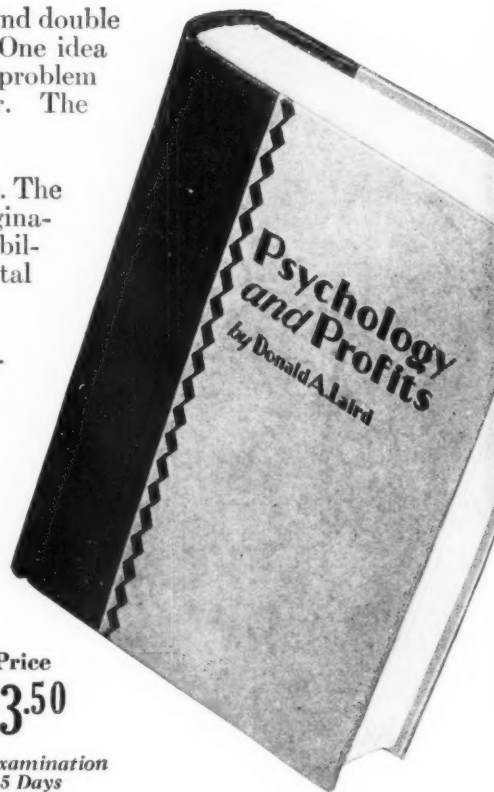
Human nature is the most unstandardized thing known. The possible variations in human make-up stagger the imagination. No two men in this wide world can be alike in ability. To get the most out of each man, therefore, is a vital problem which only psychology can solve.

Donald A. Laird, director of the Colgate Psychological Laboratory, and one of the highest paid Consulting Psychologists in America, has gathered into book form the fruit of his many years of intensive research and experiment in laboratories of human engineering—and in **PSYCHOLOGY and PROFITS** he applies psychology to business and *makes it earn more dividends.*

The ideas in this volume as first used to solve the intricate problems of Dr. Laird's business clients cost them thousands of dollars. Now you have an opportunity to get this accumulated wisdom in permanent form for 5 days *free* examination merely by tearing and returning this coupon.

Price
\$3.50

Free Examination
for 5 Days



DO YOU KNOW THAT—

—hard work is the sign of a misfit? The right job is always *easy*?
—sour people have poor memories?
—a mental age of twelve is needed for driving a car safely?
—there is an area on your desk that is most effective for working?
—each long service man under you is really a new man?
—while Police Commissioner in New York Theodore Roosevelt made a psychological discovery that led him to discover General Pershing?
—most executives have a “yellow streak” that costs business millions each year?

—most old-fashioned “craftsmen” were just lazy dabblers?
—the slow worker is not the accurate worker?
—the best years for learning are from sixteen to twenty-five?
—ultra-violet light does not benefit factory production?
—George M. Cohan has a good reason for carrying his office in his hat?
—enforced idleness can be used to hatch new ideas?

—most of your workers are in fact only one-armed?
—private offices should not be placed at the rear of a general office?
—industry is handicapped by The Bishops' Error?
—Germany excels us in manpower engineering?
—sleeping with one's problems helps bring solutions?
—rubber heels are unwise for the man who lacks confidence?
—you have to hire a family to fill one job?

**Psychology
and
Profits**
by Donald A. Laird

At Your Bookstore or on Five-Day Approval from

**B. C. FORBES PUBLISHING COMPANY,
120 Fifth Avenue, New York City, Department S. A.**

I want to read “Psychology and Profits.” After five days I will return it to you, or remit \$3.50. Please send me the book.

NAME

ADDRESS

Looking Ahead With the Editor

January—Automobile Number

"WHAT car shall I buy this year?" is a question that begins to disturb the thoughts of many people about the first of each year. Others who do not wish or do not need a new car but who are progressive and keep abreast of the times, who watch every trend and development in industry, begin wondering what the next year's cars will be like. To satisfy both these groups, we shall present in our January issue a survey of the automobile industry—as completely as possible in limited space—giving information as to new models and outstanding developments of a large number of the best known cars. Also a detailed article on the Cord front-drive car, another which explains what has been learned by engineers at the annual races at Indianapolis, an article full of human interest concerning the grueling tests on an automobile proving ground, and still another dealing with the gasoline research laboratories which are doing their utmost to help the motorist, will be included in the issue. Besides these, there will be many short items on independent developments and the usual variety of science articles.

Element 91—At Last

PROTACTINIUM—radioactive and possibly a future substitute for radium, rarer in ores but relatively plentiful in wastes from radium extraction plants, and with a life 20 times that of radium—has been studied in oxide form. An article ready for release gives some illuminating information on this metal.

Wire Webwork

ALMOST half enough wire to reach from the earth to the moon will go into the Hudson River Bridge cables. How that wire—which can sustain a weight of 7600 pounds—is spun into cables by means of "spinning" wheels which move back and forth across the river on a tramway cable like monster spiders or slow shuttles on a loom, will be told in a coming article.

Air

"CITIZENS in about half the United States are forced by law to live in air that is harmful." *Forced by law!* This statement from a forthcoming article seems rather rash but the author is an authority and cites facts to prove what he says. He continues with a discussion of air which disproves a number of old "scientific" theories regarding the air we breathe.

Every Issue Fully Illustrated

Men are known by the magazines they read. What easier road to distinction could there be than reading the SCIENTIFIC AMERICAN—at four dollars a year?

Among Our Contributors

Lester D. Seymour



DURING the World War, Captain Seymour served as Aircraft Maintenance Officer of the 85th Aero Squadron in France. After the Armistice, he took a course in aeronautical engineering in the Ecole Supérieure d'Aeronautique in Paris. Resigning his commission in 1919, he became consulting engineer in the office of the Chief of the Army Air Corps. He became affiliated with the N. A. T. shortly after its organization and since has held several positions and is now General Manager.

Horace H. F. Jayne

EDUCATED at Harvard, Mr. Jayne was a member of the first and second Chinese expeditions of Fogg Museum, Harvard College. Since 1923 he has been Curator of Oriental Art at the Pennsylvania Museum of Art. He has been Director of the Museum of the U. of P. since May, 1929.

Ida Treat

MISS Treat, an American born in Cleveland, was educated at Western Reserve University. Later she taught the Romance languages for some time. She went to the Sorbonne to take her doctorate in Romance languages and there married a French artist who was afterwards elected a deputy to parliament from Ariège. They spent their summers at Foix, the caves of which were already known to Miss Treat's husband. In consequence of this, she became interested and began the study of physical anthropology and of osteology.

David Masters

ONE of the select few writers who can present his subject in a style at the same time lucid, technically correct, and possessive of a popular appeal, Mr. Masters is an English writer of several books which have been well received in England. One in particular, "The Wonders of Salvage," has been acclaimed the best on the subject. Having written this, Mr. Masters took a special interest in the job of salvaging the German fleet and has written interestingly of this huge undertaking and of his own visits to the scene of operations.

S · A · F · E

Features of Ford Plane

All-metal (corrugated aluminum alloys)—for strength, uniformity of material, durability, economy of maintenance, and structural safety.

Tri-motored (Wright or Pratt & Whitney air-cooled engines, totaling from 900 to 1275 horsepower)—reserve power for safety.

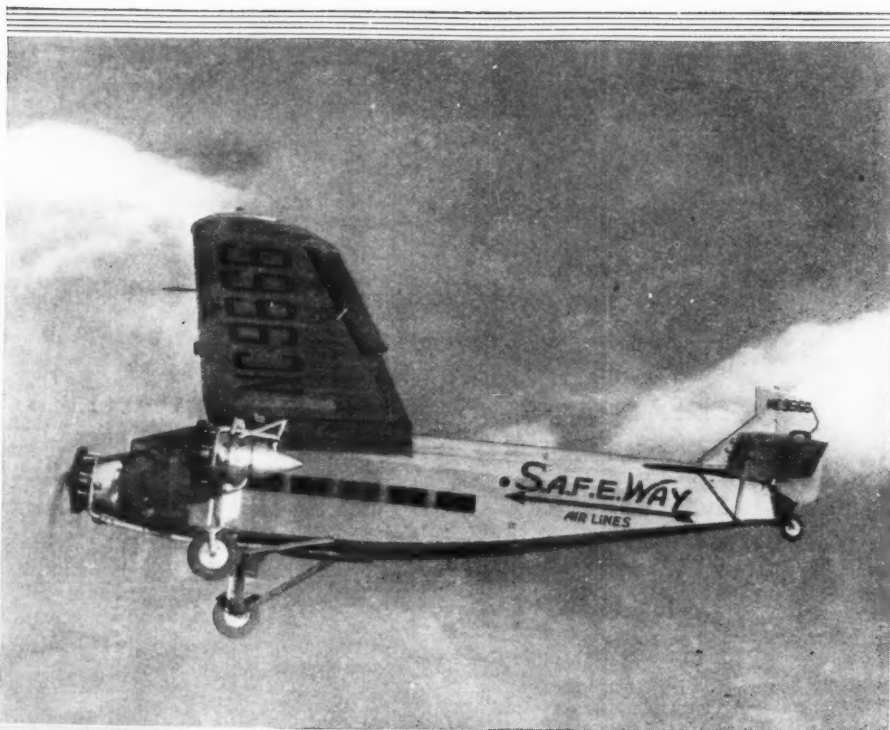
Speed range—55 to 135 m. p. h.
Cruising radius, 580-650 miles.
Disposable load—3670 to 5600 pounds.

High wing monoplane (single, stream-lined, cantilever wing)—for strength, speed, inherent stability, visibility, clean design. . . .

17 capacity (including pilot's dual-control cabin)—Buffet, toilet, running water, electric lights, etc.

Durability—Uniform all-metal construction is insurance against deterioration.

Price, \$42,000 to \$55,000 (standard equipped at Dearborn)—Exceptionally low because of multiple-unit on-line production methods.



Passenger transports should take no chances! . . . The S-A-F-E uses three-motored Fords to insure a wide margin of safety



With great distances to be traversed . . . scattered points of rich productivity to be visited . . . the Southwest is ideal for air transportation

SOUTHWEST of St. Louis and Kansas City is a great region that probably expresses American modernism more accurately than any other. It is rich. It is decidedly virile. It is one of the most alert regions in the world. It is logical, therefore, that this region should be the scene of one of the most pronounced and successful developments of commercial transport aviation. . . .

Colonel Halliburton, who established the Southwest Air Fast Express, has already in operation a fleet of nine tri-motored, 14-passenger, all-metal Ford planes. The S-A-F-E is right up to the minute in every phase of modern transport. Company limousines and five special aerocars transport passengers direct to and from downtown districts and the transport planes. Scheduled connections are made with all important trains.

St. Louis . . . Springfield . . . Tulsa . . . Kansas City . . . Coffeyville . . . Oklahoma City . . . Fort Worth . . . Dallas . . . Wichita Falls . . . Sweetwater! All these are connected by schedules designed to work in conjunction with the railroads . . . so that far distant sections of the country are brought within twenty-four hours' plane-train ride of each other.

The safety factor, as much as anything else, determined Col. Halliburton in the choice of Ford tri-motored transports . . . since three engines provide the necessary margin of safety in carrying passengers. From the inauguration of service on April 2nd, over 2500 miles have been flown daily.

FORD MOTOR COMPANY

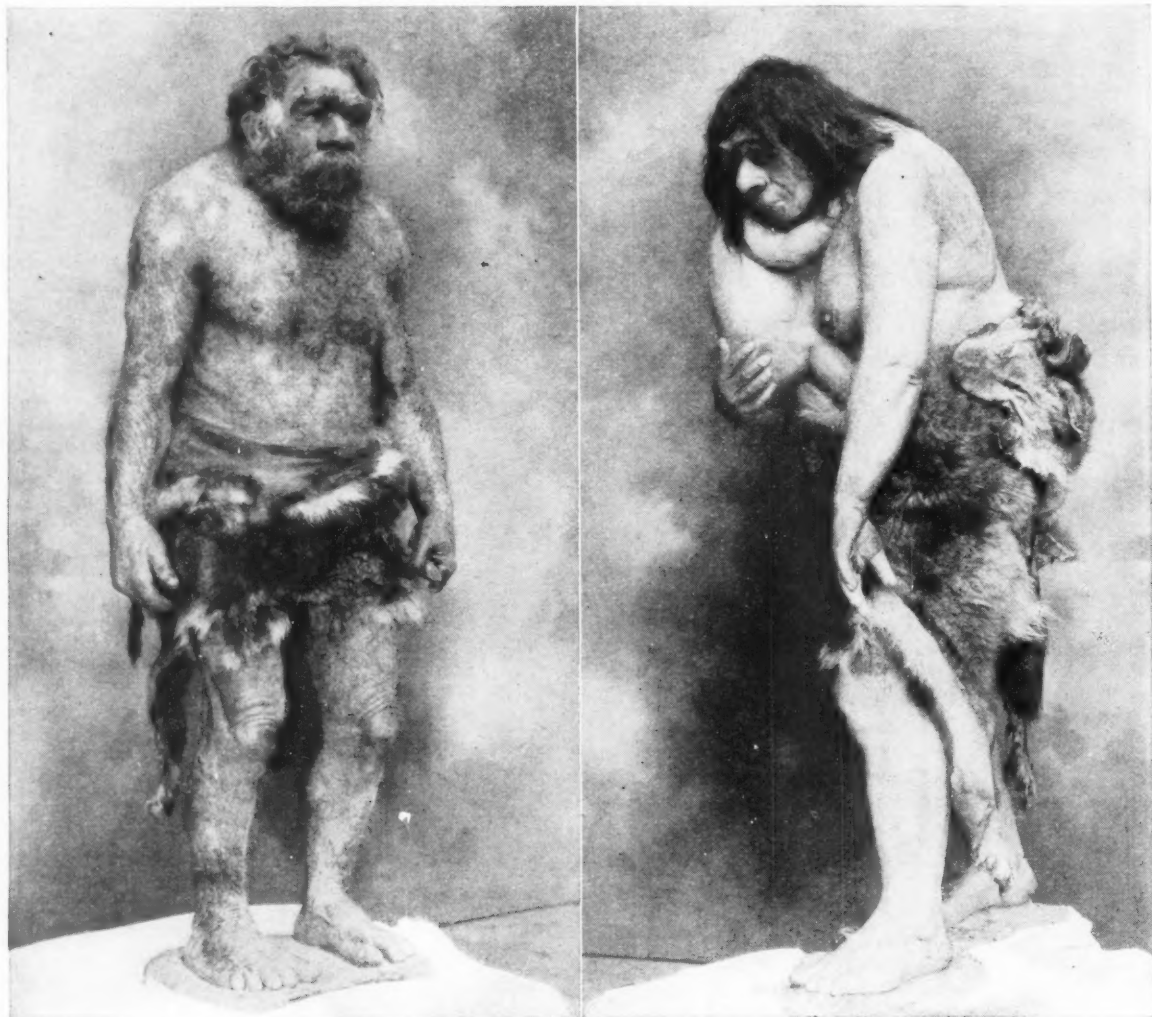
Visitors are always welcome at the Ford Airport



C. Leonard Woolley

FOR the last eight years leader of the Joint Expedition of the University of Pennsylvania Museum and the British Museum at Ur of the Chaldees, Mr. Woolley is recognized as one of the world's most famous archeologists. He is a graduate of Oxford University and for over 20 years was director of excavations in Nubia, Italy, and England. The joint work of the two museums named above has proceeded at Ur during a number of years. These have been most profitable years, for an immense number of highly valuable objects and evidences have been unearthed from the windblown and other desert deposits which had sealed them from the elements and from the un-

scientific searcher down through the centuries since the days of the Sumerians 5000 years ago. One of the most notable and striking pieces of work accomplished was the excavation of the great mound at Ur revealing it as the ancient "Ziggurat," a solid pyramidal mass of brickwork 200 feet by 150 feet in extent and 50 feet in height. According to Mr. Woolley "The Sumerians, the authors of the Ziggurats, came into Mesopotamia from a mountainous country. When they moved down the plains they built artificial mountains of brick where God might have his seat as of old on the holy hills." An article putting forth some of Mr. Woolley's work appears on page 492.



Mousterian Man, Woman, and Infant—a Race That Became Extinct

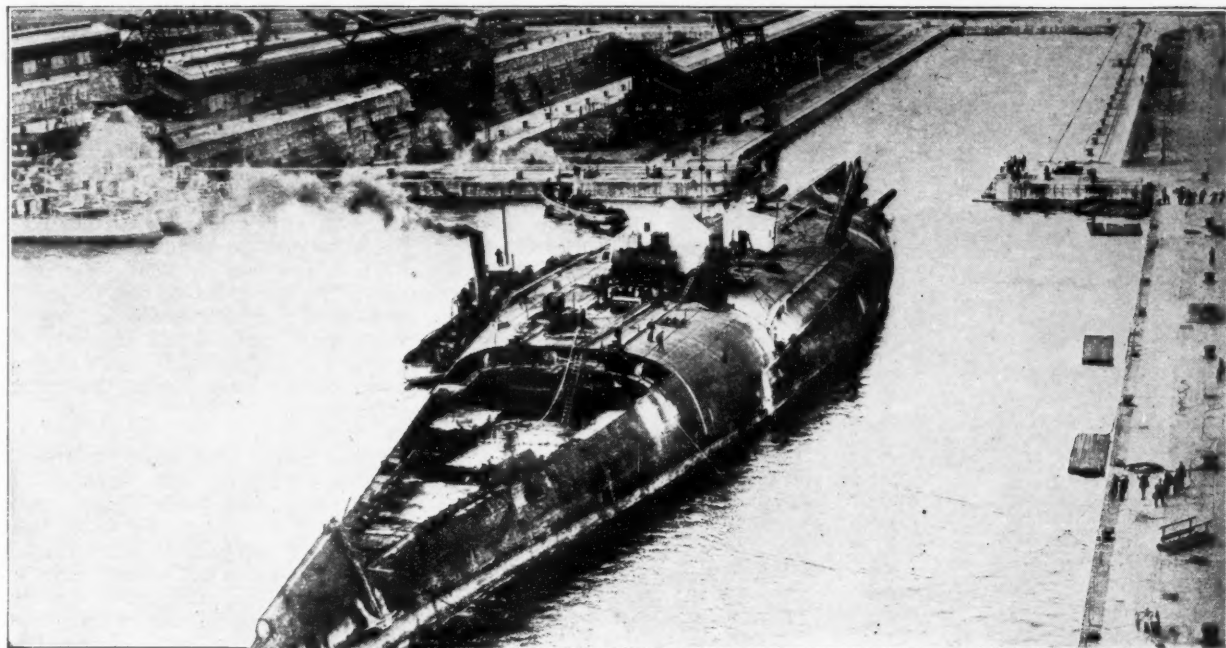
IF you could rub Aladdin's lamp and be transported miraculously to the southern part of Europe as it was 50,000 years ago, you would soon get a glimpse of the Mousterian cave man, or Neandertal man. Perhaps you might stumble on him near the caves whose mouths supplied his habitation. How would he look?

Of this we have no direct information. There are no authentic illustrations of Mousterian man, and he left no drawings of his race on the rock walls of his caves. In reconstructing his physical form, anthropologists have studied more than 20 skeletons, some of them in excellent condition. From these it is possible to derive his posture with accuracy. The bent knees and short thick necks, the large forward inclined heads and chunky bodies, are as scientific as a fact in physics or chemistry, for the shape and angle of the contact surfaces at the joints provide the data, and similar measurable data is provided by other skeletal details.

When, however, we come to supplying the superficial features, we find greater difficulty, because there are no fossils of the fleshy parts. Some anthropologists have given him a fierce, wild aspect. Others have

made him appear stupid. There is considerable reason to doubt whether in the main he was either. The evidences of his workmanship in flint show us he was a savage, but not all savages are fierce. These evidences also show that he possessed a fair intelligence; let the reader attempt to fashion even as crude weapons as Mousterian man made and used, and his respect for the "rude cave man" will undergo a rapid rise.

In these two photographs of life-sized reconstructions now on exhibit at the Field Museum of Natural History, in Chicago, and in the cover picture redrawn by our artist from photographs of the same exhibits, we see a new reconstruction of Mousterian man—and woman—made by scientists at that Museum, with the co-operation of several of the world's ablest anthropologists, Sir Arthur Keith and Professor Elliot Smith of London, Professor Boule of Paris and the Abbé Breuil, noted expert. The designer and sculptor was Frederick Blaschke, an American, and the scene is at le Moustier in south-western France. Anthropologists feel that a closer approximation to the real outward appearance of the cave man has here been created than in any previous attempt. Science applauds the effort.



IN DOCK UPSIDE DOWN

The German cruiser *Moltke* at Rosyth, Scotland, ready to be cut up. After a year of grappling, this ship was finally raised from where it rested upside down in the seabed

A Scuttled Fleet Is Salvaged

The Romance of the Difficult Job of Raising the German Fleet From the Bottom of Scapa Flow

By DAVID MASTERS

OF all marine salvage feats, none will compare in magnitude with the raising of the German fleet from the bottom of Scapa Flow. It is the biggest wreck-raising job the world has ever seen, and the most wonderful thing about it is that it is being achieved by a man who, before he went to that lonely lair in the Orkneys, had never raised a ship in his life.

When the Germans sank their fleet, Mr. E. H. Cox knew nothing about salvage. He was busy dealing in metal, and his business acumen had brought him a snug fortune. The world was crying to turn the weapons of war into plowshares, so Mr. Cox bought the obsolete British battleship *Orion* and cut her and her giant guns to pieces in order to throw them into the melting pot. Then he looked round for other scrap, and a big German submarine testing dock passed into his possession. He was about to cut up this dock, when his mind was directed to the mass of metal represented by the sunken German fleet.

Could it be raised? The experts thought not. They were not keen to

tackle the task. Cox pondered the matter. He owned a German floating dock that could lift a couple of thousand tons so he decided to try raising the scuttled ships. This man who had never raised a ship, bought 27 of the wrecks. They consisted of 25 torpedo boats and destroyers, the flagship *Hindenburg*, which was resting upright on the bottom and seemed a reasonable proposition, and the *Seydlitz* which lay with her side above the surface like a stranded whale and which did not seem so promising.

COX towed his floating dock to Scapa Flow and embarked on his sea of difficulties. The experts waited for the trouble to begin. They had not long to wait. Cox cut his floating dock in halves and rigged a series of winches on the edges. He proposed to moor each half of the dock with a destroyer lying between, place hooks through the port holes of a sunken ship, and set men winding her up from the bottom.

An American concern had previously proposed to lift ships by placing hooks through the portholes, and I had already prophesied in my book "The

Wonders of Salvage" that the hooks would tear through the plates of the vessel. Cox himself tried one hook and learned his first lesson. It tore through the plating. So he fell back on the proved plan of placing slings right under the keel of the ship and lifting her as in a cradle.

The salvage expert puts his faith in wire ropes. He knows their worth. Cox, however, had the giant anchor chains of the *Orion* in his yard, and he thought that if they were strong enough to hold a battleship they must certainly be strong enough to pick up a little torpedo boat without breaking.

Two men may take the ends of a stick and pull for a life-time without pulling the stick apart, whereas one man could take the same stick in his hands and, by putting his knee in the center, break it easily. Something like this happened to the links of that mighty chain, links so large and heavy that I could barely move one. A pulley wheel acted like a man's knee, and soon links were flying about like shrapnel.

Men shouted, threw themselves face down where they stood, others rushed to the workshops for safety.



WATER IS PUMPED OUT

In an attempt to raise the *Hindenburg*, water was pumped out of her for days. Cox finally let her sink

The flying metal made reports like gunfire, and the destroyer, which had been peeping above the surface, sank quietly down again. Fortunately, by a miracle, not one man was touched by the flying metal.

Then Cox tackled the job in real earnest with wire lifting ropes. His first wreck was raised and beached near his depot in six weeks from the time he started. He set himself to do the work faster. With a wage bill of 2500 dollars a week, each day meant money.

Where other experts had taken perhaps a day to pass one cable under a ship, he originated a plan whereby he passed cables under in the record time of 40 minutes. By slipping a cable under the stern of a ship and winding her up so that only her bow rested on the bottom, he left a gap between her keel and the sea-bed and so made it possible to manipulate the cables in place from the floating dock without sending divers down.

COX cut down the time taken to raise his second ship to 12 days; his third ship he raised and brought home in six days. On occasions he has started work, wound up his ship, and towed her home in three days. This is his record. In the early days when I first went up to inspect the work he had expended over 200,000 dollars on his salvage plant, and all he had got in return were three torpedo boats. He has since raised 25.

If troubles assailed him while he was lifting the torpedo boats, they were as nothing to the difficulties he faced

over the *Hindenburg*. He spent a fortune of 150,000 dollars preparing to lift her. For months the divers were busy patching and making her watertight, stopping the portholes and rips with a special cement that hardened in 24 hours, and cutting through pipes and driving plugs into them.

There were 250 patches in the *Hindenburg* when pumping operations began. Day after day the pumps drove out the water and the ship began to stir in her bed. As she began to rise, she showed a tendency to list. To counteract this, Cox drove an old destroyer full of cement hard ashore and sank her. From the masts of the battleship he fixed six-inch steel cables and made them fast to the destroyer ashore, hoping this would prevent the ship from heeling.

His hopes were in vain. As she rose and exerted her pull on the cables, she snapped them like cotton threads. She heeled more and more, but he pumped on, hoping against hope to get her. She was all but afloat, heeling so badly that every moment those around expected her to overturn.

Had Cox sent down a diver to see what was wrong, he might have got his ship. But he was afraid she might overturn while the man was under her, and he would not risk a diver's life. He decided at last to let her fill and sink again. She still rests on the bottom (at the time of writing) waiting to come to grips with the man who swears he will get her.

The disappointment of the *Hindenburg*, which carried to the bottom all Cox had spent on her, would have finished most men. But Cox set his teeth and determined to try to raise the *Moltke*, which was lying quite submerged and practically upside down. A few years ago the greatest experts would have pronounced the feat to be impossible.

Cox grappled with the *Moltke* for a year or more and got her in the end.

Then he tackled the *Seydlitz*, and got her, too, after a titanic struggle. In November, 1928, he turned his attention to the overturned battle-ship *Kaiser*, and I rushed north to be in at the death. The tender brought me to the tugs which were ceaselessly pumping air into the upturned battle-ship.

Above the surface the air-locks leading into the interior of the wreck stood up like towers.

"Would you care to go inside her?" Cox asked. "It will be all right if your heart is sound."

Where other men went to work, I decided to go to watch. I climbed the iron ladder up the side of the air-lock. Mr. Cox struck four heavy blows to tell those within to close the inner door of the lock so that we might enter. A few minutes later the compressed air began to shriek from a valve as it escaped and lowered the pressure inside the lock until it was equal to the pressure of the outer atmosphere.

THE heavy iron door on top of the lock dropped inwards and I went down the ladder. No man could open that door when the lock was full of compressed air. A man swung it upwards into place. A valve was turned, and it seemed that all the locomotives in the world were letting off steam at once, as the compressed air began to shriek its way through the tap into the air-lock.

"Let me know if you feel ill, and we will go out," Mr. Cox said.

I swallowed continually to adjust the pressure inside my ear-drums with the increasing pressure of the air in the lock. Once or twice I felt as though my head were about to burst, but at the proper moment I managed to click open the tubes leading to my ears and adjust the pressures and all was well again. I swallowed hard. I held my nostrils tightly and blew down them to force open the tubes and adjust the pressure on my ear drums. I watched the air pressure



A TURBINE ROOM UPSIDE DOWN

Flashlight photograph of workmen in the turbine room of an upside-down ship. A turbine hangs overhead

dial swing 'round until the whistling and shrieking died away and I knew that the pressure in the lock had been raised to the same pressure as that in the ship.

The door in the center of the lock dropped down to disclose a hole leading into the murky depths of the

overturned monster. Lighted by electricity there was a fluid black as ink, moving with an oily motion, far below. A little iron ladder tucked out of sight beneath the metal floor was pointed out and I swung on to it and between the inner bottoms of the ship. Everywhere was red rust and oil fuel and coal dust. The mess was appalling. To the touch, everything was filth.

Down one ladder after another I climbed, through holes that had been cut in the plating, and into the stokehold. The furnaces were upside down in front of me, full of red ash that was spilling through the grating on which I stood; a German shovel was wedged upside down in a corner beside a slice and rake; everything upside down.

I MADE my way to the engine room, the floor over my head, the ceiling under my feet. Looking down I saw the lamps which once illuminated the ship. They stood up on what was now the floor. I wrenched one away to serve me as a desk-lamp and a souvenir. Although it had been 10 years at the bottom of the sea, it had only a little water in it, and the electric bulb still lights as though it were right out of the factory.

At the end of an alleyway I saw some oily water and thought that if it were only a foot or so deep, I might wade farther on to explore things. Luckily a question concerning the depth was asked.

"Only 40 feet," came the reply, and I was glad I had not stepped over.

Feeling my way in utter darkness down a passage, I worked along inch by inch with my feet. Detecting a gap ahead, I stretched out farther and found a ledge on which I walked and so came to the refrigerating chamber which was dimly lighted through a small aperture. When a portable lamp was brought, I marvelled how I had made that journey along the passage without slipping into water up to my middle, for I had walked on a couple of small pipes all the way, and the gap was full of water. So does Fate take care of fools.

At an offer to stir up the refrigerating chamber for me, I shook my head. I remembered that men would not work in the refrigerating chamber of a ship which overturned in New York harbor because of the stench.

The workman laughed. "You'd want a gas mask," he added.

It seems incredible that this overturned battle-ship of 25,000 tons, sunk in the middle of Scapa Flow, could be controlled and floated by pumping air into her as though she were a pneumatic

tire. But since the hull of a battle-ship is built to keep out the sea, it follows that if the ship be upside down on the seabed and all apertures in the hull be stopped, any air pumped into it will be automatically trapped. As it cannot break through the strong steel sides, the air will collect in pockets that will gradually press the water inside the ship downward until, if enough air be pumped in, the ship will become so buoyant that she will float to the surface like an empty bottle.

The grave problem is that of balancing her. Her weights are not evenly distributed; she is heavier aft, where all the machinery is located, than she is forward. If her bow rises, all the air aft will tend to run forward, letting her stern down and pushing her bow still higher. And if the bow rises too high, apertures which have been beyond the reach of the workmen may let the air gush out and you may lose in 10 minutes as much air as you have been able to pump into her in three or four days.

IT is therefore necessary to make all the bulkheads inside the ship quite tight so that air cannot leak out of one compartment into another. Then by regulating the pressure in the various compartments it is possible to balance the ship evenly, bring her to the surface, and tow her home.

It sounds easy, but in actual practice it is most difficult. Battle-ships are a mass of pipes and tubes leading all over the place. One undiscovered pipe leading into another compartment may upset the work of days, for the air may gush through it into a place where it is not wanted and the

leading from one part to another. The bow of the ship is made into one compartment by a cross bulkhead. Two bulkheads running lengthwise divide the middle of the vessel into three compartments, while another



NO PREVIOUS EXPERIENCE

Mr. E. H. Cox standing on the hull of the overturned *Kaiser*, his foot on a patch

cross bulkhead makes another compartment of the stern.

Three days before I arrived, the last bulkhead had been made good and an attempt was being made to correct the list of the ship. Some of her top hamper had buckled under her as she turned over in sinking, and she lay with the list of $8\frac{1}{2}$ degrees.

All day long the compressed air shrieked its way through the valve on the higher side of the ship. Cox was allowing the air to escape so that the dead weight of the ship would depress that side, while air was being pumped into the lower side of the ship to raise it and thus correct the list.

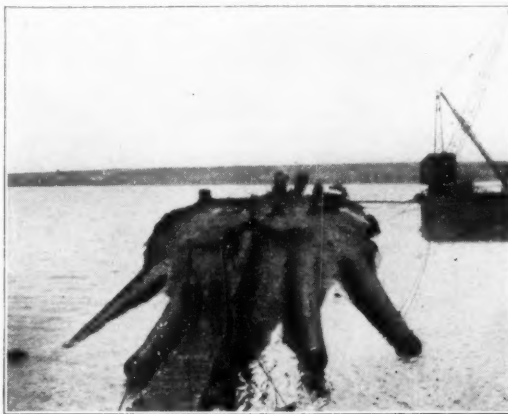
FOR hour after hour, Cox stood alone watching the plumb line hanging from one of the air-locks. Chalk marks made periodically on the visible portion of the bottom of the ship immediately below the plumb-bob told him that she was slowly righting.

Once the ship lurched violently during the operations. "It's all right," he said, as men came up from the air-locks in her interior. "She has just

slipped off the corner of her conning tower, which was stopping her from coming over."

A diver went down. "She's a foot off all the marks I made this morning," he reported.

"Tomorrow," said Mr. Cox, and the notables of Stromness were with



LIKE A GIANT OCTOPUS

A unique view of the battle-ship *Seydlitz*, upside down. What appear to be guns are propeller shaft housings

work will have to be started all over again.

Unfortunately, Cox had no plan of the *Kaiser*, so his men had to explore and gradually feel their way. For months divers with 30 or 40 men have been working away in the interior of the ship trying to stop all openings

me on the tender when we came to the wreck the next day.

The compressors were driven at full speed. Air poured into the after-end of the ship. The bow was already slightly above the surface. Towards afternoon I began to see air spilling badly from the port side and from the three propeller shaft housings. I guessed she was losing air as fast as it was being pumped in.

Down went a diver and found that one of the torpedo tubes had not been made quite tight, so the attempt was suspended and the men fought to stop the leaks. It was a difficult job, but was finally completed so that when air was once more pumped into her, the *Kaiser* came up from her bed of mud.

The salvage of the huge *Seydlitz* tried Cox sorely. She lay, as I have remarked, on her side, and he determined to lift her in that position. He first stripped from her upper side the belt of about 1800 tons of armor plate. Pumping air into her, he found she was rather unstable. This was not surprising, for as the ship showed a tendency to rise, the turrets and guns resting with their sides on the bottom naturally sought to swing under, turning the ship completely upside down.

COX used his powerful lifting docks to pull in the opposite direction and prevent her from going over; he even fixed half a torpedo boat filled with cement to one side of the ship and used it as a weight to press that side down. He tried other means to stop her, but he could not control the monster. She became so buoyant that one afternoon she swung upside down, snapping the huge nine-inch steel cables along one side of the dock as though they were silk and pulling 12-inch steel bollards out of the side of the dock as though they were tacks. The snapping cables would have cut men in two as easily as a wire cuts

cheese, but once more the workers escaped death and injury. New airlocks were then fitted to the bottom of the *Seydlitz*, which was now uppermost, and eventually she was raised and towed to Lyness, where I found her being kept afloat by compressed air.

I underwent the ordeal of going through the air-lock in order to climb



COMING UP

Bow first, a great battle-ship rises to the surface after being filled with air

down inside the turret practically to the seabed. There was the same infernal shrieking as the pressure was raised, the same efforts on my part to equalize the pressures, and then I went down ladder after ladder and came at last to the turret which had been cut through all the way around.

The ship was actually floating about six inches above the turret from which it had been severed by oxy-acetylene torches. That job had taken six weeks and the resultant fumes had been so dense that the workers had to don gas masks; otherwise they would have been overcome.

I crept into the 15-inch space between the outer turret and the inner shell, and washed the filth from my hands and rubber boots in the clear green sea. The seabed was about six

feet below me, the surface nearly 50 feet above, yet I could dabble my hands in open water. There were no strong steel plates or plate glass windows to keep it from gushing through that gap. The invisible wall which held it back was just air, the air we breathe, highly compressed. To the sea, the air inside the ship formed an impassable barrier. The salvage wizard had pumped this great ship up from the bottom with air as if she were a balloon instead of a 24,500-ton battle-ship.

The *Seydlitz* inside was a topsy-turvy nightmare. I explored the depths of her down to the turbine room, where the mighty turbines hung above my head supported by a few bolts, and I could not help wondering whether any of the bolts would break away while I stood beneath. In the next compartment the big condenser, from which the tubes had been stolen while she lay on her side, hung under a labyrinth of pipes that twisted and snaked their way higher and higher into the dim recesses above.

What the ultimate cost of salvaging the *Kaiser* will work out at remains to be seen, for at the time of writing she still has to make the passage to Lyness, before she can be made ready for the long tow around to the Firth of Forth. And before she can make the passage to Lyness, many obstructions that would foul the bottom of the channel have to be cut away from underneath her. Anyway, I suppose as scrap she must be worth about 350,000 dollars, so she is a prize worth picking up.

Whenever in future I hear that a thing can't be done, I shall remember Mr. Cox who tackled the biggest salvage job in the world without any experience at all. He might have been living in comfort enjoying a large income, but instead he chose to go to the solitudes of Scapa Flow to do a man's job that will become a classic in the history of marine salvage.



AT WORK ON THE "KAISER"

The bow of the *Kaiser* showing her list. The craft to the right busily pump air into her while divers patch any leaks that appear



READY TO BE TOWED AWAY

The *Kaiser* afloat, showing airlocks, which made possible her raising, standing on her bottom. Note size of people amidships

OUR POINT OF VIEW

Lindbergh: Scientist

FLYING over a section of Yucatan, Mexico, which is entirely blank on the maps, Colonel Lindbergh has, according to press reports, discovered from the air and located on the map several hitherto unknown ancient Mayan cities. It is the first time archeological flights have been made in this hemisphere, although Roman ruins have been found in England by the same modern method (See SCIENTIFIC AMERICAN, September 1929).

While some 1200 archeologically important sites in Mexico are known, it is believed that dozens, perhaps hundreds, more are hidden in the densely matted jungle. In the past, gatherers of chicle for chewing gum have accidentally discovered some and their paths have helped scientists to penetrate the jungle in search of others, but a deliberate quest for those in inaccessible regions has been considered rather a hopeless task. An expedition might pass within a few feet of important ruins and be unaware of their existence. From the air, however, the story is different. Columns and masonry stand out clearly and, where overgrown entirely, temple sites and even paved Mayan pathways may be patterned in the coloring or relative growth of trees and plants that cover them.

On one flight it is reported that Colonel Lindbergh and his party, which included Dr. A. V. Kidder of the Carnegie Institution, found four ancient city sites and located them on the maps so that ground expeditions can cut their way directly to them. This flight alone is sufficient to prove the value of the airplane as an aid to archeological discovery. Polar exploration from the air started slowly but, in time, led to Captain Wilkins' antarctic discoveries and to Commander Byrd's great effort; we dare predict a like extensive use of the airplane for exploring the Mayan region.

Clean Iron Workers

"WHITE collar" workers have lamented their lot for years but, from present indications, a new tribe, the "white pants" workers, will always sing the praises of the men who tried out a bit of clothes psychology on them.

There is an indefinable something about neat, clean clothes that exerts an inspiring influence on all of us. If one is well-groomed, he feels that he is sitting on top of the world; he feels more ambitious and energetic and his work is benefited accordingly; if he is

careless and slovenly about his clothes, his work . . . ! Therefore, when a group under one foreman in a plant of the American Rolling Mill Company came to work one fine morning in white trousers and white shirts, other departments followed suit. In this plant there is considerable rivalry between departments to keep down

Fatal Accidents

ACCORDING to Dr. Louis I. Dublin, of the Metropolitan Life Insurance Company, the United States has a higher percentage of fatal accidents than any other country in the world. For each 100,000 in population, this country had 78 fatal accidents in 1927 while Scotland had 50, England and Wales 38, Germany 36, Sweden 35, and France 29.

This deplorable state of affairs, instead of being remedied, is growing worse. In 1928, the number was the highest on record. This is partly accounted for by the fact that automobile accident fatalities, numbering 27,500 in 1928, top the list; they are responsible for almost a third of the total. Serious, non-fatal automobile injuries during that year reached the figure of 950,000—or nearly one percent of the country's population! And, strangely, the rural districts are experiencing a more rapid increase in motor fatalities than are the urban centers.

To what factors in our lives may we attribute this alarmingly high rate of death by accident? Our possession of a greater number of automobiles than any other country explains, as indicated above, almost one third of the number but that does not greatly lower our relative percentage over that of other nations. Are we evidencing, in a distressing trait of recklessness, the development of definite racial characteristics? Is it speed-mania—or what?

Think it over. "Safety first" as a slogan is out of date. "Safety always" is more to the point. "Take care" that recklessness is not soon labeled with a "made in America" tag!

accidents, the one showing the best record winning the plant trophy; and no department was going to let another get ahead of it in anything that might influence that record. The white clothes had the effect of stimulating departmental pride. Floors were kept free of oil and dirt as much as possible and there seemed at once a marked improvement in the work per-

formed. While the idea is still in the experimental stage, it is felt that it cannot but have a beneficial effect on safety and quality of workmanship.

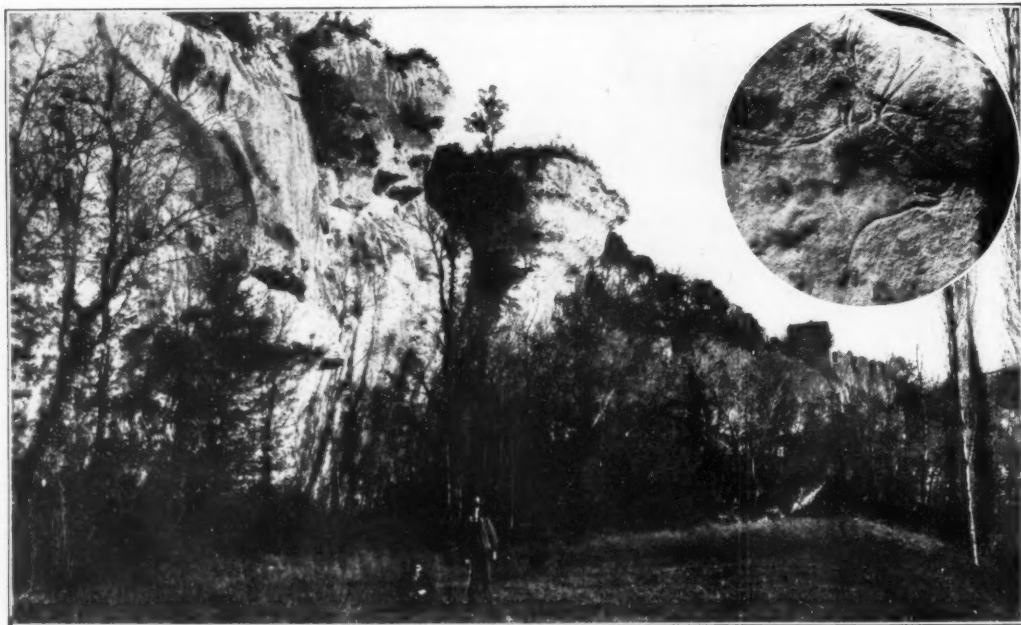
This change is indicative of what is happening in modern steel mills. With the development of the new continuous mills and other innovations, cleanliness has become a reality in an industry that has long been handicapped by working conditions that it was thought could not be improved.

Fur Farming Misconceptions

WITH the establishment of complete fur farms and of small fur ranches on lands of little value for crops on general farms, the business of raising animals for their pelts is assuming the character of a big industry. Due to the increasing scarcity of certain fur-bearing animals in their wild state, the business may prove important economically in the future. Foxes, fishers, martens, minks, otters, skunks, raccoons, opossums, beavers, muskrats, and rabbits have been studied in captivity and it has been shown that fur can be produced profitably by farming some of these animals; indeed it is now being done on a large scale and as a sideline.

For years a glamorous picture of fur-farming profits has been painted by unscrupulous dealers in fur-animal breeding stock and many people have been deceived. Interested persons have been led to believe that they can fence in a piece of rugged, perhaps worthless, land, turn loose a few animals as breeding stock, feed them a little, and collect annually a sizeable dividend in the form of pelts from the increase in their stock. These people close their eyes, consciously or unconsciously, to the pitfalls in the path of the beginner.

"Successful breeders of fur animals," says Frank G. Ashbrook in "Recommendations to Beginners in Fur Farming," published by the Department of Agriculture, "either must possess or must acquire a clear conception of the important factors involved in breeding. Persons with no experience would do well to obtain employment on a fur farm and thus familiarize themselves with the principles of the business before attempting it themselves." The lure held out by the unscrupulous dealer usually is accompanied by too heavy risks and it is better for the beginner to start with a few pairs of animals and gradually increase the number as knowledge and experience are gained. Like any other business, fur farming can be successful only after much study and more hard work.



LA MADELEINE IN THE VALLEY OF THE VEZERE, DORDOGNE, FRANCE

The cave man did not live in the caves but at their mouths; more often, however, he chose to make his camp at the foot of overhanging cliffs like these—dry, with a sunny exposure. Insert: engraving at La Madeleine

When Reindeer Roamed the Pyrenees—I

A Glimpse of France, "The Capital of the Prehistoric World," In the Days of the Cave Man

By IDA TREAT, Ph.D. (SORBONNE)

Co-author of "Primitive Hearths in the Pyrenees"

CLIMBING the French Pyrenees in August is like climbing any mountain: as you mount higher, you step back over the seasons. Down in the valley, the first apples may be ripening. But overhead in the beechwoods, it is still July; the raspberry patches dear to woodcock and bear, show red with fruit. Where the pines begin, you can find wild strawberries. Higher, rhododendrons blossom among the rocks; and where the snow lies in hollows, if you look carefully you may even discover a belated daffodil.

When you reach the peaks it is winter. Here nothing grows but the hardy *réglisse* and wiry grass burnt yellow from the ice the August sun has melted. This is the last refuge of living things that love cold—sole survivors of the beasts the cave man hunted in the plain below when Europe lay in the grip of the last glacial period and southern France was a desolate tundra with a climate like that of northern Siberia today.

Thousands of years ago the last hairy mammoth disappeared; with him vanished the woolly rhinoceros, the cave-bear, and giant deer. The herds of reindeer followed the retreating ice

towards the arctic north. Today only the chamois and the ptarmigan or white partridge remain, exiled to the eternal winter of the mountain-top.

FROM the top of Mont Valier, the highest peak of the Ariège Pyrenees, you look down on the fertile basin of the Garonne river and conclude that *la douce France* has been rightly named. Behind, to the south, lies Spain—arid, rocky slopes, dusty pine woods, and barren foothills. But before you to the north stretches a soft green country: valleys with glistening torrents, heather-covered foot-hills; and beyond, an undulating plain of vineyards, grain-fields, and pastures, extends to the horizon.

From southeast to northwest, a low range of foot-hills cuts 'the plain obliquely, its green surface broken here and there by patches of gray rock. This is the ridge of the Plantaurel or Little Pyrenees. Deep in its flanks lie many of the great prehistoric caves of France, caves which thousands of years ago served as sanctuary or shelter to nomad hunters of the Old Stone Age. The Plantaurel stands at the heart of the cave country, the underground prehistoric world that

reaches out on the north to the gray cliffs and rock-shelters of Dordogne just out of sight beyond the horizon. For 50 years, scientists have explored and excavated the region, piecing together the story of Stone Age civilizations whose traces today lie buried beneath tons of earth and rock or hidden in the deep recesses of the caverns.

Seated today at the foot of a stone cross that marks the summit of Mont Valier, you may find it difficult to picture the country below as it looked when the cave man lived there. In fancy you become a spectator of the mighty panorama of the ages. First you imagine the setting of the panorama; you look down on an arctic landscape, 50,000 years ago, perhaps even earlier. In the place of vineyard and pasture, a vast stretch of steppe and tundra overgrown in summer with harsh grass and stunted bush, and in winter a snowy plain swept by the blizzard. This is the first tableau: the Pyrenees country just before the cave man came there. The caves of the Plantaurel ridge still shelter their original inhabitants: the wolf, the hyena, the lion, and the great cave-bear. Over the plain wander migrating herds: mammoth, rhinoceros, horse,

deer, and bison—the first “road-breakers,” checked in their westward course by the barrier of the Atlantic and the icy wall of the Pyrenees.

Into the picture come men following the trail of the game; Stone Age hunters, from the unknown land of their origin. Perhaps from farther north where other more primitive races have dwelt for centuries. These, the first human beings to appear in the Pyrenees country, belong to the race of Neandertal. You see them shuffle bent-kneed across the steppe, burly fellows with long ape-like arms and heads that sag curiously between heavy shoulders. Low-browed and dull-witted, they are nevertheless mighty hunters. They drive the savage beasts from their dens in the Plantaurel in the caverns of the rock.

THE Neandertals are the first cave men. Seated about the fire at the cave entrance they eat their meals of roast meat, chip crude flint weapons, and scrape and prepare the skins that serve them for clothing. Like the animals that preceded them there they litter the cave-floor with refuse—splintered remnants of their feasts, flint chips, charcoal and ashes. In time, the layer of refuse grows thick and compact. Sometimes, moving on to other campgrounds, they leave behind them in the cave one of their own dead. These men know nothing of art. What religion they may have finds its sole expression in a few vague burial customs. They are hunters and on the steppe there is no lack for game.

Centuries pass; tens, perhaps hundreds, of centuries. The climate is steadily growing colder. Now a new element appears in the picture. Across the horizon come tribes of men on the march towards the west. Perhaps they come from Africa, perhaps from

the distant plateaux of Mongolia. A new race. Tall and well-built, they stride erect over the snow. They too wear garments of skins, but carefully cut and sewed. On breast and arms are ornaments, shells and pierced teeth strung on thongs. They carry fine weapons—darts and dart-shooters of carved bone. Their faces are streaked with paint.

These, the men of Cro-Magnon, are the first modern men, modern from a physical point of view, to appear in the Pyrenees region, or in fact in Europe. There is nothing ape-like about them. Their predecessor, the dull-brained man of Neandertal, for all his victory over the beasts, is no match for the newcomer. His race, his civilization, are doomed to disappear. The Cro-Magnons drive him from the country, exterminate him everywhere, and in turn take up their abode in the caves he vacated.

They too are hunters. They track herds of bison and reindeer in the plain, drive wild horses to suicide over the cliffs, and set traps for rhinoceros and mammoth. Clever craftsmen, they manufacture fine tools of chipped flint and carve weapons of ivory and bone. On the cave floor their kitchen refuse lies in a thick new layer above the old hearths of the Neandertals.

But game is no longer so abundant on the steppe, frozen now throughout the year except for a few short months. To secure sufficient food and clothing it no longer suffices to be strong,

vigorous, and clever. Nature is hostile to animals and men alike. In his daily struggle with cold and famine, the Cro-Magnon hunter learns to invoke supernatural aid. He develops a cult of fecundity, essential in an inhospitable land where the absence of game means famine and where the existence of the tribe depends on the vitality of its members. In the dark inner galleries of the caves he performs magic rituals. By the light of a torch he carves on the rock walls the symbols of his cult. He resorts to “sympathetic” magic and traces or cuts on the soft stone the outline of the beast he plans to hunt, marking its flank with the dart or arrow which he hopes on the morrow will bring down the desired game.

AND so art is born for the first time in man's history, fully 30,000 years ago. As the years go by, the caves of Dordogne and the Pyrenees become veritable underground galleries filled with hundreds of animal paintings and engravings, the work of the Cro-Magnon cave man, the world's first artist.

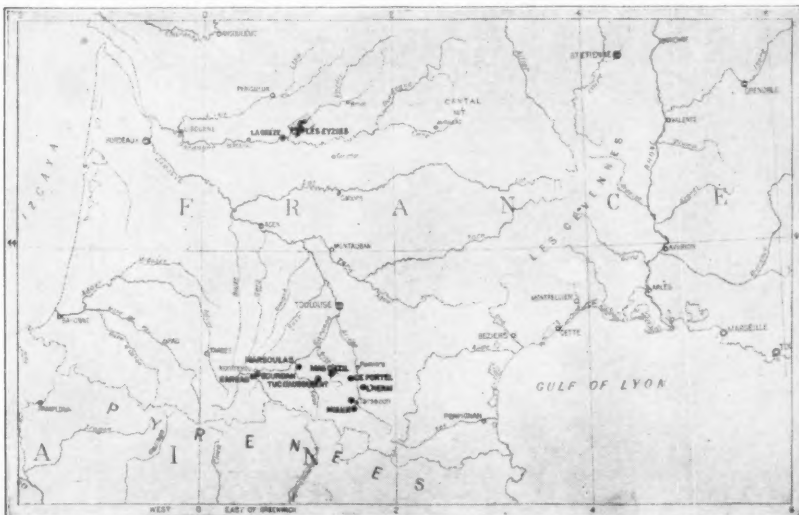
Again centuries pass by tens and hundreds. The splendid race degenerates, defeated at last by the unfriendly land. The stature of the Cro-Magnons decreases; they become stunted like the dwarf bushes of the steppe. The old religious cult breaks up into a complicated tangle of magic practices. The noble stylization of the first art forms gives way to exaggerated realism. But the working of flint and bone attains a rare degree of technical perfection.

Again the panorama shifts. Even



ROCK OF LES EYZIES

Les Eyzies (see map below) is called “The capital of the prehistoric world.” It abounds in caves and cave art



Courtesy The American Museum of Natural History

THE TWO MAIN PREHISTORIC REGIONS OF FRANCE

The northern area is referred to as “the Dordogne”; the southern as “the Pyrenees.” The caves, under government control, are open without formality to tourists. There are small inexpensive hotels and a visit to the regions will repay the scientifically minded

the landscape changes. The glaciers, the snows are melting. All the land runs with water. It grows green; the forest begins to grow. The mammoth has gone; the reindeer is going; deer and wild boar roam the underbrush. In the Plantaurel and in Dordogne the caves are still inhabited—perhaps by a new race that has come from no one knows where. Perhaps too by degenerate peoples of the old Cro-Magnon strain. The present dwellers in the land are Azilians, fisher-folk for the most part, who share none of the cults or rituals of their predecessors. They know nothing of art, beyond tracing geometric signs on pebbles from the river-bed. They are not even clever artisans. The fine technique of working flint and bone has disappeared with their predecessors.

The last civilization of the Old Stone Age is drawing to a close. And the curtain drops on the imaginary panorama as new tribes stream westward over the horizon—peoples of the New Age of Stone, come to plant the first grain fields in the plain below the Pyrenees . . . 10,000 years ago.



Photograph by Max Högmann

A DIFFICULT PASSAGE

Made easy, however, by a ladder installed in the cave of Tuc d'Audoubert, in Ariège

While the Stone Age cave man undoubtedly chose his rock-dwellings for reasons of convenience rather than scenic beauty, the cave country of Dordogne and the Pyrenees is today one of the most picturesque spots in France. To be sure, the Ariège Pyrenees affords few hotels for tourists and few convenient methods of communication. The modern traveller has generally to supply his own means of getting about, whether by automobile or bicycle; or if not pressed for time he may find it even pleasanter to rely on his own legs.

Quite apart from the prehistoric underworld there is much to charm and interest the traveler above ground. Wild mountain country, pine and beech-forest, trout-stream and cascade, high lakes like mirrors of steel among the peaks that border Spain and Andorra. Slate-roofed villages cling to the mountain-side, and far below are lyric valleys with poplar-bordered streams, velvety pastures, and low red-tiled farm houses. Perched on a rock above the valley stand walls of medieval castles; manor houses lift their peaked towers behind oak groves and clustered orchards. An arched gate recalls the Moorish invasion; a block of sculptured marble reveals the site of a Roman villa or temple.

DORDOGNE, originally a part of the old province of Gascony, also has castles and manors in a rich setting of green. It is a mellow land of wine and famous cookery; the humblest inn can provide a meal guaranteed to tickle the most jaded palate.

Where the Vézère River glides among fields and gardens through a valley bordered by cliffs of gray limestone, you discover with amazement that the troglodyte tradition still persists among the present inhabitants of the region. All along the base of the cliff cling modern houses, houses with only three walls and half a roof; the natural wall of rock supplying the missing portions to the structure. Far overhead, the cliff projects over the valley, so that not a drop of rain falls on the roofs beneath.

When the cave man lived, thousands of years ago, in huts of branches and hides, on the site of these modern dwellings, the top of the cliff must have projected even farther. Great masses of stone have

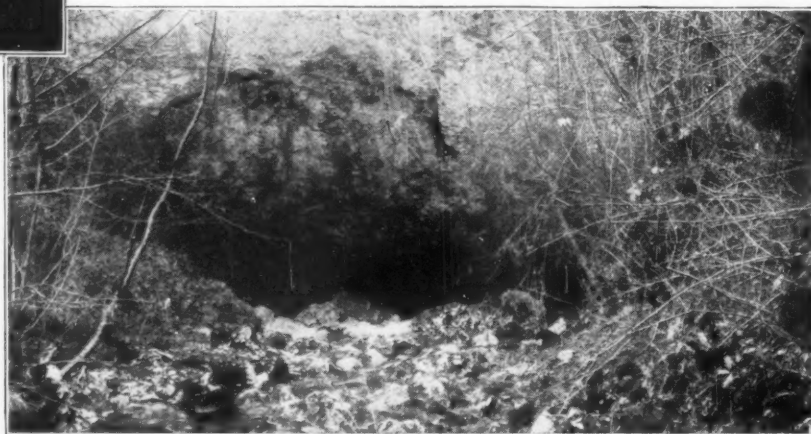


PREHISTORIC SCULPTURE

Head of mountain sheep, Dordogne. The sculptor had nothing but stone tools

fallen; here and there great blocks lie along the valley floor. The thought that other such blocks might again fall does not seem to disturb the present cliff-dwellers in whom long habit may have developed a peculiar sort of fatalism. A series of horizontal grooves in the gray surface of the cliff—scars left by the roof-trees of houses long since disappeared—shows that the population of the Vézère valley has lived in the shelter of the rock for centuries, perhaps without interruption from the days of the prehistoric cave man.

Grouped about the modern town of Les Eyzies, in a series of little valleys that radiate star-fashion from the main thoroughfare of the Vézère River, lie the famous prehistoric sites of Dordogne. Most of these occupy rock-shelters rather than true caves. Some consist of a single chamber opening in the face of the cliff; others extend along its base in the meager shelter of a projecting ledge. Where the men of Neandertal built their



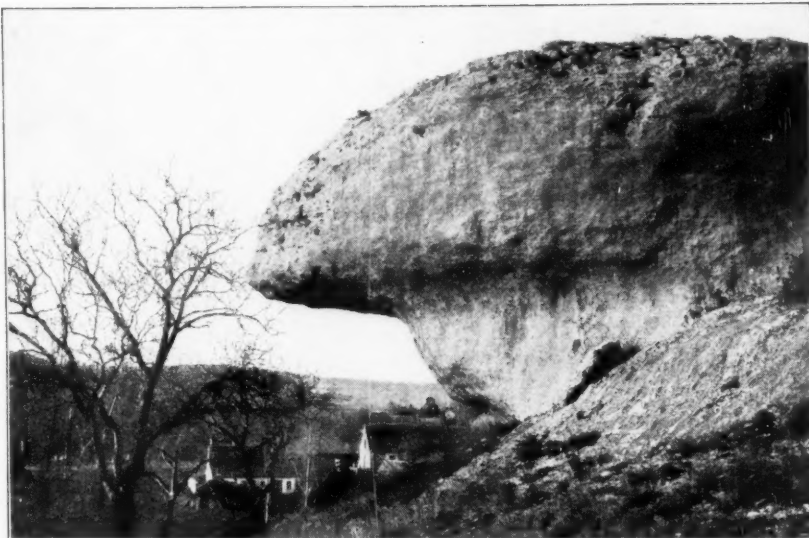
ENTRANCE TO THE CAVE OF ENTERE, ARIÈGE, PYRENEES

The caves are in soft limestone and, like those of Kentucky, have been dissolved out by acid ground water. Several noted caves of France start where streams emerge, like this one

camp-fires the excavator finds beneath a surface layer of debris the most ancient prehistoric hearths of the region: stones blackened and split by heat, bones of rhinoceros, horse, and bear, and quantities of flint instruments and chips. The refuse heaps left by Cro-Magnon man and his descendants hold richer treasure; a great variety of art objects lie in the litter of ashes and animal bones—engravings on stone, bone, and mammoth ivory; and weapons and tools finely carved in reindeer antler and bone.

BARELY a stone's throw from Les Eyzies, two underground "art galleries" pierce the cliff above the Vézère river: the caves of Font de Gaume and Combarelles. The first contains mural paintings of bison, reindeer, and mammoth; the second, an intricate tangle of animal figures cut out by a flint tool on the rock wall. Both caves are shallow, merely a few hundred feet in length, and were known and visited long before scientists realized that they contained specimens of the cave man's art. The proximity of the outer air and the vandalism of early visitors who blackened walls and ceilings with names and dates in candle-smoke have partially obliterated the prehistoric paintings. On the whole these are not nearly so well preserved as those of the Pyrenees caverns in which the cave man's murals are often located a half mile or more from the cave entrance. Nevertheless the animal figures of Font de Gaume and Combarelles rank among the best examples of Old Stone Age art.

The Cro-Magnon artist of Dordogne was also a sculptor. In the rock-shelter of Cap Blanc, excavators uncovered a frieze of horses carved in high relief along the base of the cliff—



OVERHANGING ROCK SHELTER IN THE DORDOGNE

Various races living in such shelters for thousands of years gradually built up the floor several feet thick with stratified debris, animal bones, and lost or discarded flint implements



ROCK SCULPTURES IN RELIEF, FROM THE CAVES OF FRANCE

The various types of animals portrayed correspond closely with those which are found in the caves in fossil form. Sometimes they are lacking in perspective, but seldom in posture



THE ROCK OF LES EYZIES AND PREHISTORIC MUSEUM

Les Eyzies is a hamlet amid scenic surroundings. It has two clean little country hotels and the scientific visitor may to advantage spend a few days there visiting a score of caves

horses which for sheer beauty of line and form might well be compared with those from the Athenian parthenon. The vault of another shelter bears several delicately sculptured fish; a third yielded curious human figures in bas-relief—one of the rare occasions when the cave artist, who generally limited his work to the extant forms of animals, for possible reasons already suggested, portrayed the men and women of his day.

The prehistoric underworld of Dordogne has been more completely excavated than that of the Pyrenees. What excavations are still in progress have been placed under the control of Monsieur Peyrony, Director of the Prehistoric Museum of Les Eyzies, which occupies a partially restored castle that clings to the rock of Les Eyzies, towering high above the little town. (See photograph at the left.)

(To Be Concluded)

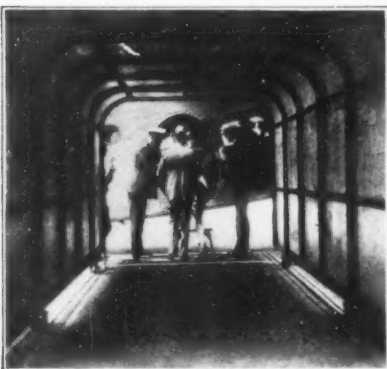
From the Scrap-book of Science



NOT AS DEADLY AS IT LOOKS: A "MOVIE" MACHINE GUN

During recent army maneuvers in which a Blue army and a Red army—composed of Regulars, National Guardsmen, and Reserves—were pitted against each other, a great deal of the mimic warfare was staged in the air. In many of

the air fights, this new "gun-camera" was used. It is mounted on a machine gun but shoots pictures instead of bullets. When the plane returns to the ground, the pictures are developed and the number of "hits" recorded

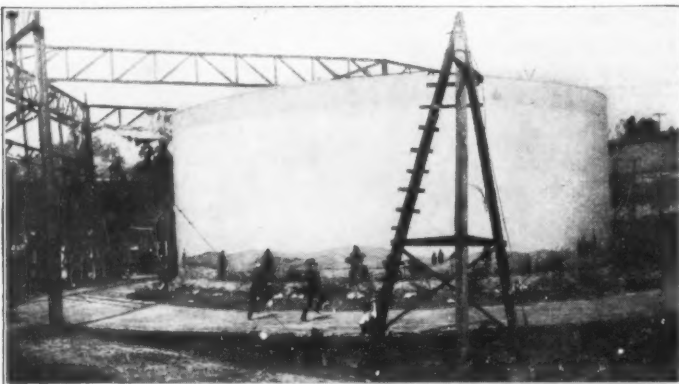
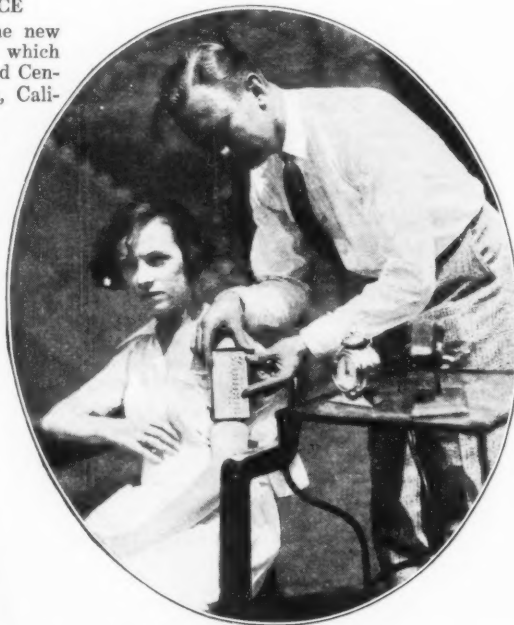


◀ AVIATION CONVENIENCE

Passengers are here using the new movable "canopy" runway which has been installed at the Grand Central Air Terminal in Glendale, California. It operates on a track and can be extended to plane to protect passengers

U-V RAY EFFECT ▶

The Health Commissioner of Chicago is testing this device which shows effect of ultra-violet rays on the skin. A 12-holed metal plate is attached to the arm and a hole is closed by shutter each five minutes

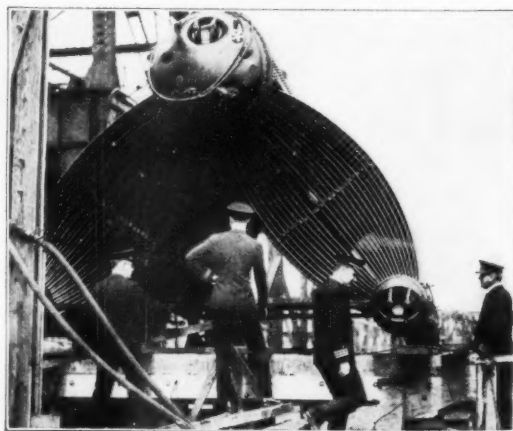


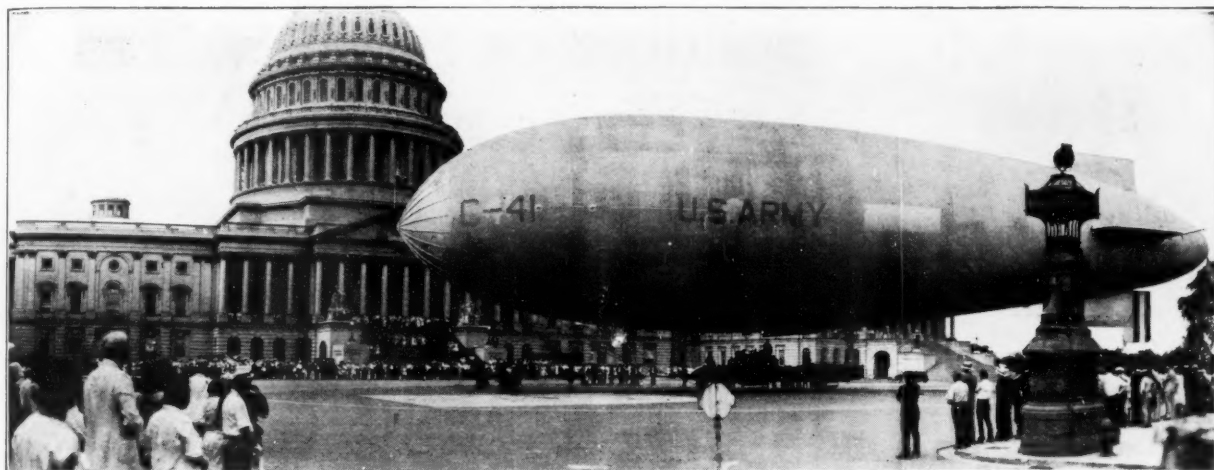
▲ IN A HURRY BUT GETTING NOWHERE

One man chases another on the huge cyclorama, 321 feet in circumference, at the Mack Sennett motion picture studio. The platform on which the men are running travels to the left while the painted scenery in the center travels to the right but more slowly. In this manner a constant change of artificial scenery is produced

THE NAVY PERFORMS A FEAT ▶

All the resourcefulness of the Bremerton Navy Yard's staff of engineers was called into play when the first of eight boilers, each weighing 70,000 pounds, was lowered into the partly completed hull of the cruiser *Louisville*. The yard's two 40,000-ton cranes did the job but had to be locked to their tracks. Rear Admiral H. J. Ziegemeir, Commandant of the yard, supervised the work





AIRSHIP TRAVELERS

Possibility of the wider use of blimps as a means of everyday travel is prophesied as a result of the two successful landings shown here. Above: Senator Hiram Bingham, at Langley Field, was called to Washington. He commandeered the blimp C-41, made the trip in three hours, and landed in the Capitol plaza. At right: the Goodyear blimp Volunteer meets a train and relays J. W. Mapel, President of the California Goodyear Company, and Mrs. Mapel to the Goodyear factory



A GLIDER SALUTES A MONUMENT

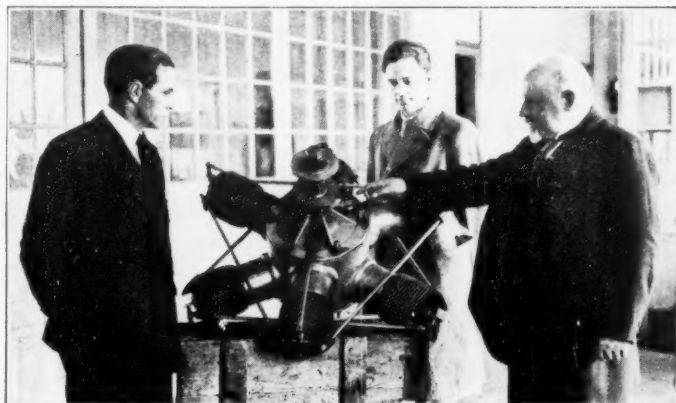
One of the glider contestants in the recent tenth annual glider contest, held by the Rhoen-Rossitten Company, flies over the Aviator Monument on top of the Wasserkuppe, Rhoen. In this contest, prizes were given for all kinds of gliding records, and many prominent aviators took part or were present. The event was marked by many notable flights. New designs of gliders were exhibited

"TALKIE" HEADPHONES

Specially designed acoustic equipment, which will enable partially deaf people to hear clearly the speaking and sound effects of talking moving pictures, has been installed in a Brooklyn theater

▼ FIRST RADIAL TYPE?

Left to right, the photograph shows Major Bert Hinkler, famous Australian flier; Mr. Leach, of Wakefield, Ltd.; and Mr. Ellehammer, inventor of what is said to be the first radial type airplane motor—inspecting the famous motor in Copenhagen, Denmark



An Office Building of the New Era

Science Contributes to Efficiency, Employee Comfort, and Convenience in a New York "Sky-scraper"

By STRATFORD CORBETT

PROBABLY no block in New York City has been the scene of more notable events or has been visited by more celebrities than that bounded by Madison and Fourth Avenues, 26th and 27th Streets. Once occupied by the depot of the New York and Harlem Railroad, this plot later became the site of Madison Square Garden which has literally been the arena where some of the most colorful spectacles of a generation have been staged.

Now, upon this famous site has been erected a new monument to the builder's art: the home office of the New York Life Insurance Company. As majestic in architecture as an old-world cathedral, this new building

are kept the records of more than 7,000,000,000 dollars of the world's insurance, have been embodied refinements which enable the company to attain an efficiency of operation and economy of motion that is little short of amazing. The system used in transferring inter-departmental and other documents is a good example in point.

It is understood, of course, that the routine of an insurance home office consists largely in passing upon, and producing, a vast quantity of paper forms. There are applications for new insurance, requests for loans on policies, affidavits regarding policy claims, dividend cards, vouchers, correspondence, and papers of an infinite variety, all of which must pass through a series of home-office departments for clerical, or special attention. The New York Life estimates that it has on file at the present time approximately 75,000,000 items of this sort.

Naturally, to transfer any number of these important documents from



NEW YORK LIFE BUILDING

The insurance company building on the site of old Madison Square Garden, as seen from Madison Square



DESK TUBE STATION

Carriers arrive in drawer at left and are dispatched from desk-top inlet at right

risers in a series of set-backs and terraces 34 stories to an elaborate pyramidal tower, or spire, the tip of which is some 617 feet above the street level. There are also five stories underground. Many critics and writers have commented upon the beauty of this building, and it was only recently that the Fifth Avenue Association awarded it first prize as the finest structure erected last year in the Fifth Avenue district; yet, impressive as is the building's beauty, still more impressive are the mechanical and scientific improvements to be found inside.

Here, in this great work-shop where

one department to another would, under ordinary conditions, require a large staff of messengers, and would consume a great deal of time. In their new building, the company has boldly solved this problem by the installation of an elaborate pneumatic tube system, said to be the largest of its kind in existence. More



THREE UNUSUAL MEANS OF COMMUNICATION

In the center are teletype machines, used to "telegraph" typed messages to other departments. At right is a tube station, while at left is a dumb-waiter running to a department above

than 43,000 feet of oval-shaped brass tubing, four by seven inches in cross-section, reach upward and outward through the quarters of the company like the nerves of some great giant.

Every department in the home office has one or more of the tube stations. From these stations, large leather carriers, each with a capacity of dozens of papers of ordinary business size, are shot at 30 feet per second through independent lines of tubing to a central station in the third basement.

This basement station is a truly remarkable place, seeming, with its long rows of twisting tubes, and slides, and chutes, more like a scene from a futuristic "movie" than an actual reality of the present.

AS they reach this station, the carriers drop automatically upon a series of endless belts which carry them immediately to receiving chutes at one end of the room. Here they are sorted by hand and sent by means of another series of belt conveyors to the correct bank of dispatch tubes. At the dispatch tubes stand operators who send the carriers to their proper destinations.

The air for the system, incidentally, is supplied by two compressors (located in a room adjoining the central station) each operated by a 75 horsepower motor, and each having a capacity of 13,000 cubic feet of air per minute at a pressure of three quarters of a pound to the square inch.

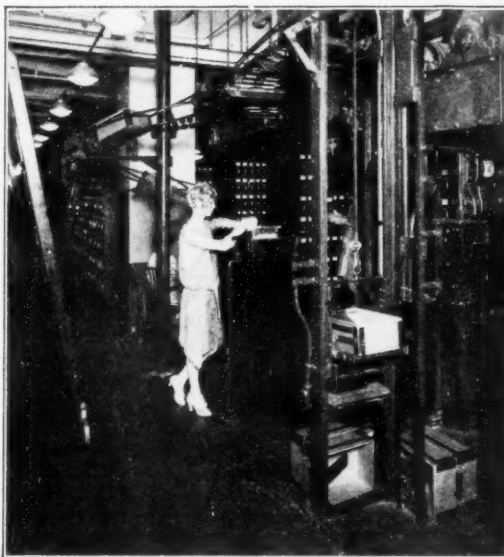
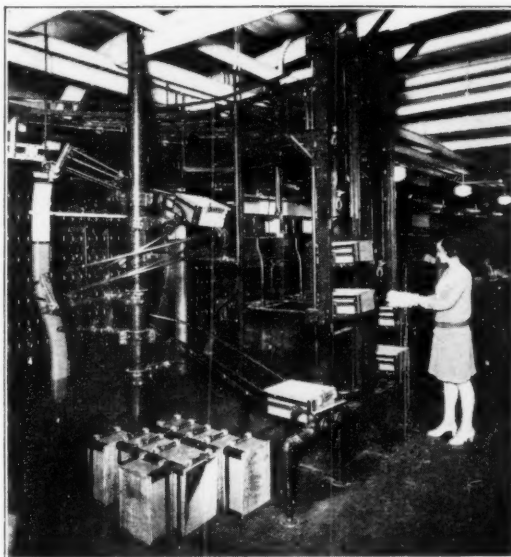
At present the company has in operation 102 out-stations—54 receiving and 48 dispatching stations. Ultimately there will be in use nearly 140 stations. Some of the out-stations, of course, are more elaborate than others. Thus, in the File Division there are, grouped together, six receiving and three dispatching stations, arranged so that the

incoming lines discharge upon a long receiving table, while the dispatching tubes are set in a table especially designed for outgoing papers. The mail room, which receives large quantities of outgoing mail each day, is provided with six receiving terminals opening upon a receiving slide, and three dispatching inlets.

In addition to the main pneumatic tube system, there are two supplementary lines directly connecting the security vaults of the company with the treasury and mortgage loan departments.

SENDING

Dispatching and receiving station of special carrier system used in file division where 8,000,000 applications are kept

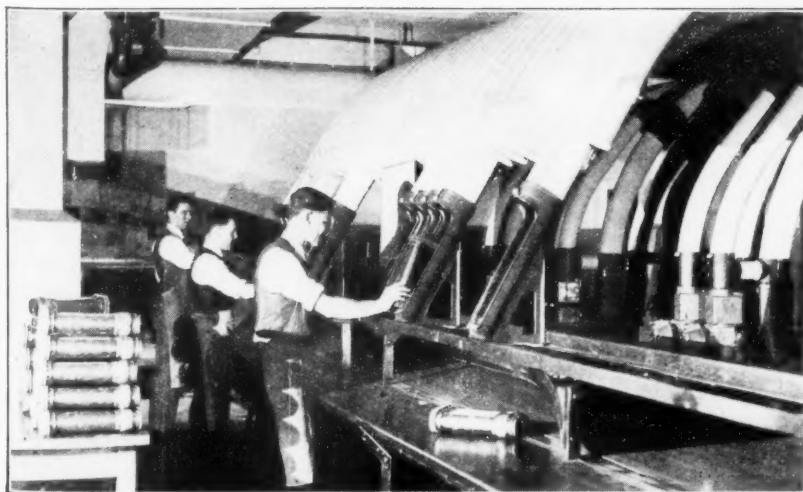


The carriers for these lines are equipped with locks and keys.

Altogether, the company dispatches in a normal working day from 7000 to 10,000 carriers, although at practically no place in the building, with the exception of the central station, the out-stations, and one room in the basement, are there to be found any outward evidences of the tubes themselves. Not only are the tubes effectively concealed, but wherever there is any possibility of hearing the passage of the

RECEIVING

Carrier arriving from station above. The system employed here combines electric hoist, endless belt, and gravity chute



SECTION OF CENTRAL TUBE STATION

One bank of dispatch tubes in the terminal room of the pneumatic tube system where from 7000 to 10,000 carriers a day are received and re-routed to their proper destination

carriers, the tubes are also sound-proofed.

This sound-proofing treatment of the building is in itself most unusual, and certainly a distinct advance in modern building practice. Imagine, if you can, a large office with typewriters and adding machines clicking away, telephones ringing, filing cabinets being opened and closed, doors shutting, clerks coming and going—but with not a sound above a murmur reaching the ears. Even the sound of the steel worker riveting outside is subdued. Such a condition, which seems almost unbelievable at first, is actually typical of the work rooms of the building, and is made possible only by an extensive installation of sound-absorbing materials.

This treatment, which was adopted for the purpose of increasing the efficiency of office workers, was planned in such a way as to prevent the trans-



VAULT TUBE STATION

Clerk opening locked carrier used in tube line connecting with security vault

mission of any sounds that originate either outside or inside the building. External noises are overcome by using heavy window glass, set rigidly in heavy frames, and by forced ventilation, so that a minimum of open windows is necessary at any time. Internal noises are largely overcome by the use of special sound-absorbing material on the ceilings, and by the proper selection and installation of sound-resisting materials.

The sound-absorbing element is a heavy layer of felt—composed of asbestos and cattle hair—which is cemented to the plaster or masonry surface with moisture-proof and heat-resisting cement. The exposed surface of the felt is then covered with a fabric selected to suit the location and the work to be done.

FOR the ceilings of the offices and kitchens, the fabric consists of a perforated oil cloth which, besides giving the maximum sound-absorbing effect, can be painted, washed, and kept in a clean and sanitary condition.

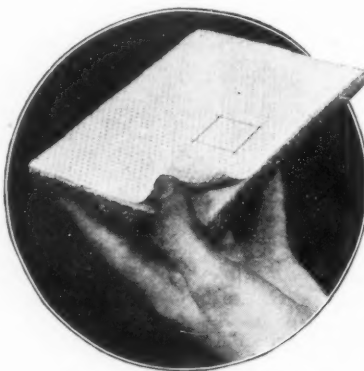
The treatment is used in all spaces where excessive noise might originate or where it is desirable or essential that quietness should prevail. Included in the spaces treated are all clerical working rooms where there is a considerable number of typewriters, adding machines, or similar office equipment, the doctors' examination rooms, laboratories of the employees' welfare department, and the pneumatic tube station. Sound-absorbing treatment has also been installed in the employees' dining rooms and kitchens, and in adjacent corridors.

In addition, all motors and machinery were, of course, placed as far

away as possible from spaces where quiet was desirable. All office partitions were made of heavy metal with the glass rigidly fastened and braced, and careful selection was made of the plumbing, door checks, door fasteners, and other equipment to insure their quiet operation.

Although only a few months have elapsed since the opening of the building, the study and precaution taken in eliminating noise have already improved working conditions very noticeably.

Still another aid to the efficiency of employees are a series of teletype machines installed in several departments. These are the same as the machines used by newspaper press associations in transmitting news to their member newspapers. The teletype machine is, in effect, an ordinary typewriter with a telegraphic arrangement by means of which a message typed by an operator on the sending machine is automatically recorded on another machine, located, possibly, several hundred feet away in another floor of the building.



APPLIED TO CEILINGS

Sound-absorbing material, of cattle hair, asbestos, and perforated oil-cloth covering

In the New York Life building, the machines are used to transmit messages to and from the dividend division, the premium collection division, the policy loan division, the surrender value division, and the actuarial division.

There is, unfortunately, not space available to tell of the many other remarkable features to be found in this building. Given the space, one might describe the gigantic boilers, five stories underground, which are stoked automatically, human hands never touching the coal from the moment it is emptied into a bin at the street level until finally, as ash, it is carried by vacuum suction up to the street and into waiting trucks. Or one might well describe the mechanical ventilating system which carries clean, oil-filtered air throughout the five basement stories, and throughout all the company offices.

One might also describe the 100-ton refrigerating plant which supplies cool drinking water on every floor, as well

as making ice cream and preserving food in storage. The kitchens themselves and the employees' dining rooms, decorated with colorful murals, are worth more than passing comment if only space permitted. Then there is the security vault of the company, the walls of which are protected by a series of finely strung wires, heavily insulated and so sensitive that the loosening of even one pebble in the wall will instantly set off an alarm. And there is the protective alley leading about the vault, fully lighted at all times, locked off by itself, patrolled by special guards—making it impossible for anyone with criminal intent to come even within striking distance of the walls.

THERE are the motors, of which there are more than 4000 horsepower in the building: over 200 motors, with an aggregate capacity of 2500 horsepower are required for building services exclusive of elevators.

There is the elaborate vacuum cleaning system which carries dirt and dust from all floors through concealed pipes to a special tank in the basement. There is the company's emergency hospital complete with women's ward, men's ward, treatment rooms, sun-ray lamps, and all modern equipment.

One could go on, it almost seems, indefinitely.

There can be no doubt that here we have a new conception of the business workshop, remarkable in its external beauty and remarkable in its application of scientific principles to modern business planning. One might say that when buildings such as these become common throughout the country there will be no excuse for any employee to shirk his duty.



SPECIAL VAULT GUARD

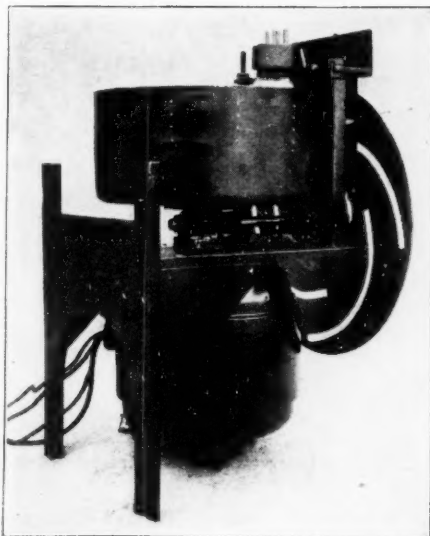
View of protective alley extending around outer walls of vault, patrolled by guard

Television's Progress

By A. P. PECK

FOR years television has struggled to free itself from the confines of the laboratory and enter the home, to provide a welcome addition or supplement to the radio telephone receiver. Up to the present time, however, all attempts have been unavailing. Many experimental television receivers are now in use throughout the country, operated by radio amateurs who have made an intensive study of the situation, but even this may be considered a step in the laboratory process of development, and not "public" use in the general sense of the word.

A year or so ago, enthusiasm for television was at fever heat, and great possibilities were forecast for radio vision in the home. However, the simple theory of television did not prove so simple in practice, and the few "receivers" that were offered for sale turned out to be worthless for ordinary use. Then came a period of further intensive research during which several television transmitters were erected and placed on regular schedule so that tests of receivers could be conducted under actual working conditions. We show below two views of the transmitting equipment installed at the Jenkins Television Corporation laboratories in Jersey City, New Jersey. This company (See also page 526, June 1929 issue of the SCIENTIFIC AMERICAN for details of its earlier work) has also completed the design of the relatively simple televisior illustrated on this page and, at the time of writing, it is said that a visual reproducer will be on the market by Christmas of this year. Simplicity of opera-



"CHASSIS"

The motor is placed in a vertical position, with the scanning drum above. At the right is the shutter



IN THE CABINET

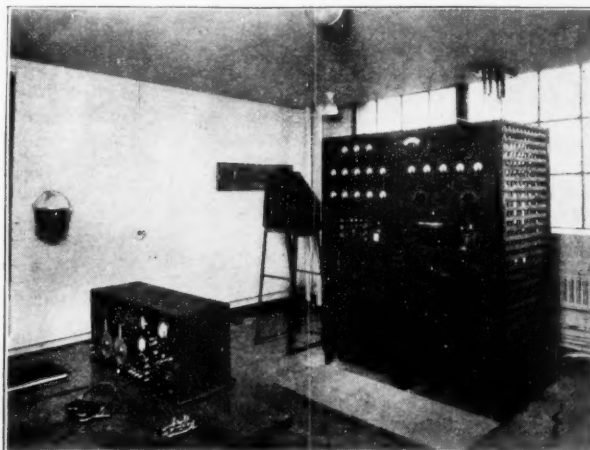
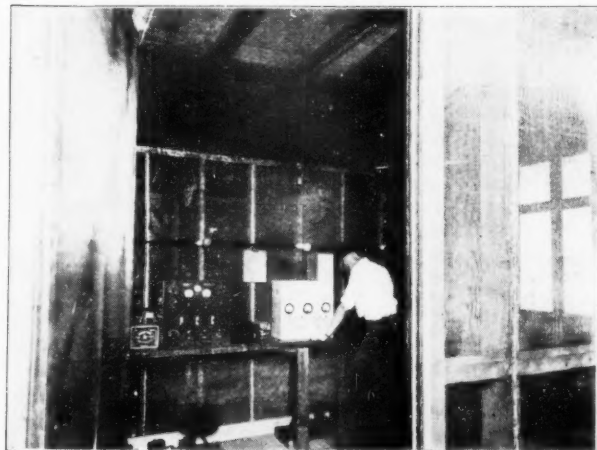
The back of the cabinet is here let down to show the chassis bolted to it. Note the large-plate neon tube located within the scanning drum, close to the front



THE TELEVISOR

ation and compactness are two qualities that are essential in a radiovisor. In the Jenkins unit, the simple scanning drum described before, (See reference above) has been retained, but a large-plate neon tube has been placed within it and the quartz or plated glass rods have been eliminated. The four-plate neon tube has been discarded and with it went the selector switch. In the present model, a slotted rotary shutter allows vision through only one of the holes at a time.

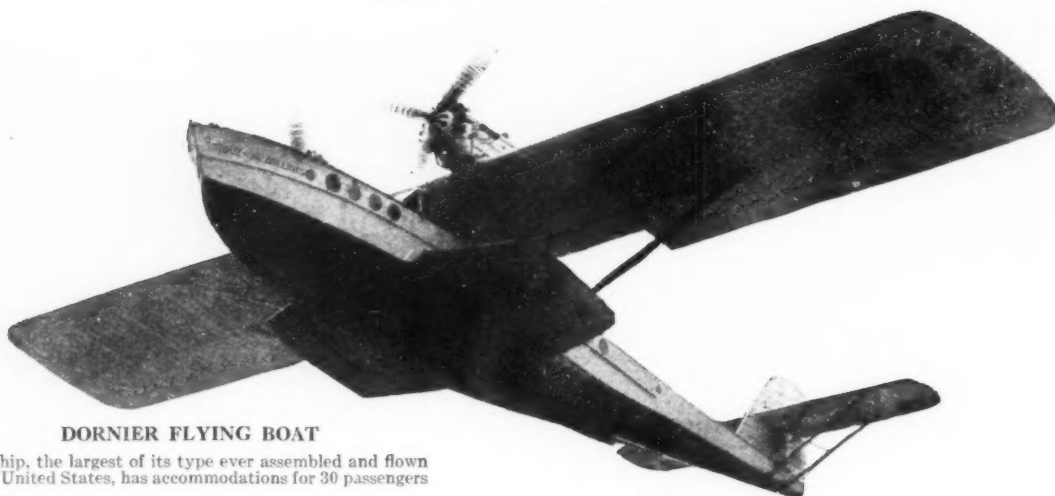
Synchronization is accomplished by the use of synchronous motors operating on 60-cycle alternating current. The mechanism is mounted on a chassis, as shown, and placed within a shadow-box.



AT THE TELEVISION TRANSMITTER

The television pick-up and amplifiers are enclosed in copper-screen cages such as at the left above, to shield the instruments

from disturbances. At the right is the transmitter with a possible output of five kilowatts, with the television monitor to the left of it



DORNIER FLYING BOAT

This ship, the largest of its type ever assembled and flown in the United States, has accommodations for 30 passengers

Giant Airplanes

Plans for the Future, and Present Successful Tests, Portend a New Era in Heavier-than-Air Flying

By REGINALD M. CLEVELAND

ARE we entering an era of giant airplanes? Will air transport of the near future be conducted in craft of wing-spread, payload, and horsepower far in excess of those now associated with passenger planes in the United States? There now seems to be a basis for an affirmative answer to both questions.

In Europe, at any rate, there is a very definite trend toward planes of large capacities. The tendency is not confined to isolated instances or to single countries. Germany—with Dr. Dornier's huge Do. X, the largest of all the big craft to have reached the stage of completion or near completion, and the biggest of the Junkers planes and Rohrbach flying boats—is perhaps in the van of this movement, but Italy presses close and Switzerland, Great Britain, France, and Spain are all at work on monsters of the air.

At least two major contentions lie behind this movement. The proponents of big planes hold, first, that in them the factor of safety is increased, and, secondly, that they are economically advantageous since, with increased size, the possible payload increases in higher ratio than does the total weight.

Both of these advantages have been claimed for the Do. X which astonished the air-minded world by its excellent performance under test last summer, when its twelve motors of 525 horsepower each lifted its great bulk from the surface of Lake Constance in 30 seconds. The safety factors stressed by its designer include its well-designed flying-boat hull, built to withstand wind currents strong enough to cause, in nautical parlance, a sea of Force 3 or

Force 4; its height from the surface of water, which brings the low point of the propeller sweep 22 feet above a smooth sea; and room completely to separate piloting and navigation compartments from the passenger portion of the ship, leaving the control personnel entirely undisturbed in the performance of their duties.

With a useful load of 44,000 pounds and a payload of 22,000 pounds, the mighty Do. X should be capable of long-range flights on a profitable basis. It can accommodate a hundred passengers. So convincing have been its demonstration flights that the Luft Hansa has already ordered companion ships while Italy has also placed an order for a counterpart.

THIS giant is primarily intended for long-range cruises in Europe. The North Sea and the Mediterranean offer fertile fields for such operation, but it is altogether probable that a North Atlantic crossing will be made, with refueling at the Azores and the West Indies. Flying boats of this and the Rohrbach make, also built on a large scale, are to be put in operation on Germany's proposed South Atlantic service, where weather conditions present a more favorable average aspect than over the more northerly ocean.

The Do. X is regarded by Dr. Dornier as but a forerunner of still larger and mightier craft and by no means the ultimate in airplane size. It was he who, about two years ago, in an address in England, exploded theories long held that there was an upward limit to the size of heavier-than-air types. He demonstrated that resistance did not

increase in proportion to the stepping up of size and that, aerodynamically, planes of enormous wing spread and wing thickness need not be confined to dreams of the visionary but can become practical realities.

Furnishing the proof of the pudding, his Do. X, with hull 130 feet long, has wings with the leading edges thicker than the depth of many an airplane fuselage. Through the wings access is had to the motor gondolas with their striking arrangement of motors in tandem, combining, with tractor and pusher, to furnish the needed 6300 horsepower. This tandem mounting, reducing as it does head resistance of a given number of motors to a marked degree, seems logical for giant planes, the size of which may ultimately be restricted only by the limitations of available motive power.

One of the two largest boats which have flown in America, purchased for passenger service on the lakes between Detroit and Cleveland, has the same motor arrangement. It is also a Dornier, built abroad but assembled at the naval aircraft plant at Philadelphia. Its four motors develop a total of 1700 horsepower, giving a top speed of 135 miles an hour and a cruising speed of 110 miles. In its test flights over the Delaware River in September it flew with capacity load at 120 miles an hour. It will carry 30 passengers. Its wing spread is 90 feet.

Another interesting sign of the big-plane movement in America is the 32-place monoplane launched in September by Anthony H. G. Fokker. This big passenger carrier, considered as whole, is the largest land plane yet

built in America. With a span of 99 feet and an over-all length of 69 feet 10 inches, it has a payload of 8700 pounds, which indicates its high efficiency, as its total weight is only 22,500 pounds. Driven by four Pratt and Whitney Hornet motors, developing a total of 2100 horsepower and mounted in tandem in nacelles under the wings, it attained a high speed of 160 miles an hour and landed at 47 miles an hour in test flights at Teterboro. Either the two tractor or the two pusher motors—the latter with three-bladed propellers—served to keep the plane at a cruising speed of 110 miles. The interior arrangement allows for the seating of 30 passengers in addition to the pilots or 16 berths can be made up for night use. Serving pantries, toilets, baggage compartments, et cetera, make it a sort of combined Pullman and club car of the air.

OF arresting interest also is the Junkers 30-passenger liner which will probably be in flight by the time this issue reaches the public. The thick-wing principle is here employed to the full and the two 800 and two 400 horsepower motors are all housed in nacelles in the leading edge, streamlined into the wing surfaces. It seems probable that the Junkers oil-burning engine, which has had successful test flights, may be used. A speed of 105 miles an hour is expected.

With a wing span of 144 feet, this big craft has a fuselage length of 64.5 feet and a height of 17.4 feet. An auxilliary motor is used to control the rudders.

The interior of the Junkers plane is arranged in two decks. The upper provides 30 seats for daytime use and 26 berths for night flying. The lower deck will be used as a freight compartment.

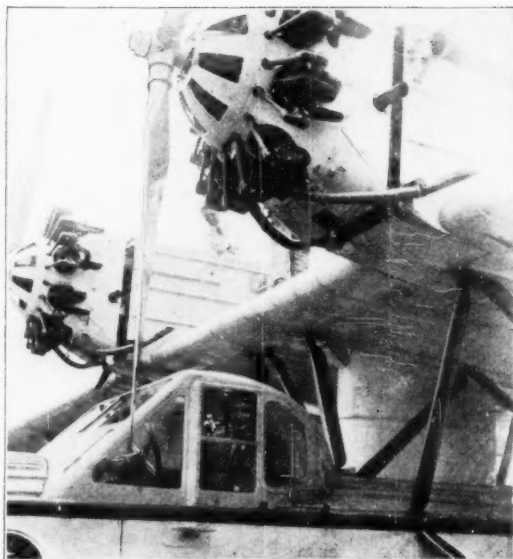
The Swiss engineer, E. Manos, has also been at work on a plane of very large dimensions and with a number of interesting novelties of design. The wing span is given at 197 feet, the length at 120 feet, and the height at 32.8 feet. This particular plane is to have a total of 6000 horsepower but in this case the power is to be derived from only six enormous motors and these will be housed in an engine

room and the six propellers operated by gearing. The arrangement is described as such that failure of two or three motors would not stop the revolution of the propellers but would merely slow them down. Flying speeds of from 118 to 155 miles an hour are expected. Beds are to be provided for passengers and the interior plans call for a restaurant and recreation rooms.

One of the most consistent and enthusiastic advocates of the large plane is Gianni Caproni, the Italian designer. The creator of a number of very large bombing types during the war, he has devoted his attention for the last decade to designs on a grand scale. This intensive work along a definite pathway is to bear fruit and to bring the exceptionally large airplane to the American field for, through the participation of American capital in the organization of the Curtiss-Caproni Company, several big passenger planes are being pushed to completion. They were inspected recently by C. M. Keys, who heads many of the Curtiss interests, and he expressed his faith in their important role in flying in the United States.

SIGNOR CAPRONI has evolved three biplanes of progressively increasing size and designated them as the 1000, 2000, and 6000 horsepower ships. The first of these types has been constructed in quantity for use by the Italian army. The second has successfully passed flight tests and the largest is complete save for the installation of the 1000 horsepower motors.

In addition, the designer places great faith in a 3000 horsepower monoplane for which he claims an aerodynamic efficiency of from $12\frac{1}{2}$ to 13. He believes that it can take off with a fuel load sufficient to give a maximum range of more than 6000 miles, but, very wisely, he does not advocate such a procedure. Instead, for the transatlantic service,



PILOTS' COCKPIT

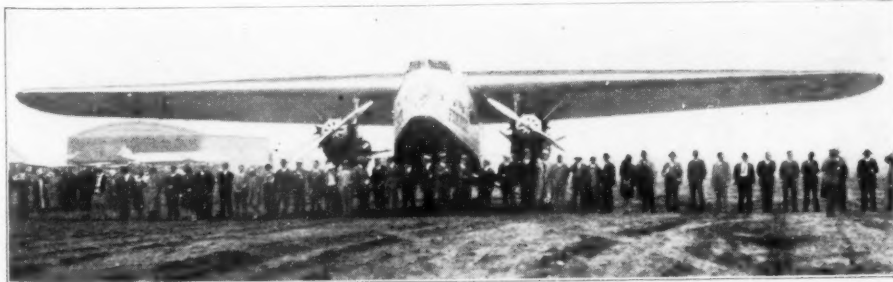
This close-up of the Dornier plane, shown on the opposite page, gives an idea of the position of the pilots

which he predicts will be in operation earlier than most persons expect, he advocates stops for refueling, which would necessitate the Azores-West Indies route until such time, at any rate, as the proposed sea-dromes prove their practicability.

For service, say, from New York to the Pacific coast, Signor Caproni declares his 3000 horsepower plane could carry five tons of payload at an average speed of 135 miles an hour and require but one stop for refueling at some point about half way along the route.

THE largest of his biplanes, the 6000 horsepower craft, has a wing spread of 167 feet. He feels that this is big enough for the present and sees no necessity of exceeding it in size. He has designed a special form of tubing for machines of this type to be used in frame construction, for which advantages of hitherto unattained lightness, combined with strength, are claimed. A service from Rome to South America is quite possible with these giant machines.

Spurred on by the evidences of the trend to big planes in Germany, Switzerland, and Italy, the British Air Ministry is bringing to completion a flying boat in the Blackburn works for which, compared with the Do. X, a greater range with equal load is claimed. Little has been revealed of the details of the craft, but it is designed to have a 1000 mile non-stop range; to carry 50 passengers; and to follow, in general principles of design, the present "Nile" type of the constructors. Size has been very greatly increased, how-

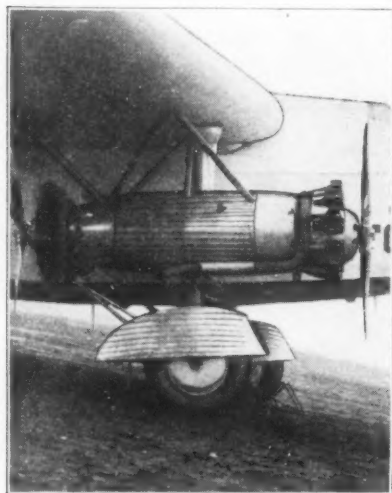


THE FOKKER F-32

This monoplane, designed to carry 32, was recently launched. It is powered with four Pratt and Whitney Hornets of 525 horsepower each, and is completely equipped for passenger comfort

ever, over that model, as the sleeping accommodations for the passengers are to be in the wings. The ship, it is understood, will be powered by three Rolls-Royce engines.

The French have also entered the big plane race and the Farman Brothers,



ENGINE MOUNTING

View of one of the nacelles on the Fokker F-32, showing mounting of the engines

whose name must ever be associated with pioneering in aviation, plan two large models at home and in the American market. The smaller is to carry 25 passengers and be driven by two motors arranged in tandem, while the larger will be four motored and have a passenger capacity of 50. A company for American production of these types is in the making.

EVEN Spain, where airplane production is not large, but interest in aviation is intense, has fallen into line. There a huge passenger craft is under construction by the Aeronautical Construction Company. It is a 50-passenger type and is to be powered by six motors of 750 horsepower each, mounted above the thick wing, which, as in the case of the Dornier design, gives means of access to the engines. The plane is expected to have a useful load of nine tons and a cruising radius of about 7000 miles.

New opportunities for profitable use in long-distance travel are opened up to these gigantic types by the demonstrated success of refueling in the air. It is quite conceivable that airline services of the near future may send up such massive types carrying only one half or one third of their rated fuel capacity, so as to make possible the transportation of more payload in the form of freight or passengers, and have them met by "nursing-bottle" planes at points well within the radius of the fuel load carried. If, for any reason, the refueling contact should be difficult or should miscarry, the plane would

still have enough fuel in her tanks for a safe power landing. Normally, however, replenishment could take place in the air and the number of landings—admittedly the operation of greatest hazard and wear—could be much reduced.

The field for planes of great size seems to lie not only in more profitable service for long water and land routes in Europe and the United States but also in speeding transportation in countries where it is now especially difficult or arduous. The Central and South American fields and those of eastern Russia and Asia are particularly attractive in this regard. Railroad communication in many of these areas is non-existent or very inefficient. The important role of the airplane in such conditions has already been recognized by those most closely associated with the export side of the industry in this country.

For example, F. B. Rentschler, President of the Aeronautical Chamber of Commerce, said recently in connection with the formation of an export subsidiary of the United Aircraft and Transport Corporation, which he also heads, that the airplane might well obviate the necessity of ever constructing railroads in lands marked by present lack of transportation facilities or by notably difficult terrain. He was not referring to giant planes, for which he does not see a demand as yet. However, the 25, 50, or 100-passenger plane—with its equivalent freight-carrying capacity—seems a logical type to employ as a substitute for railroad transport.

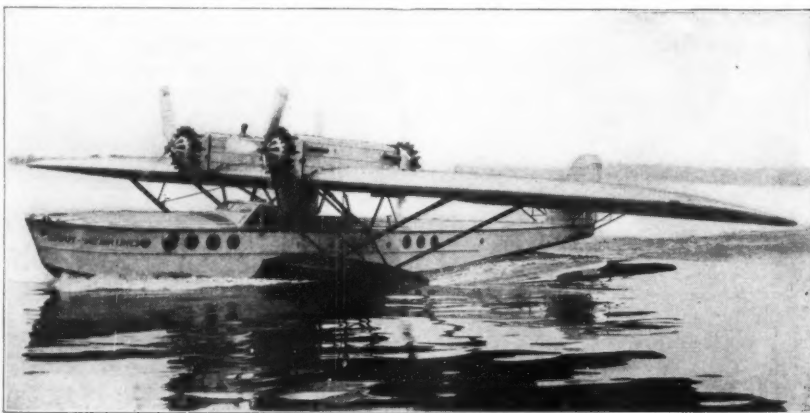
THE relative cost of establishing an airway, even when using such expensive mammoth types, and of building a railroad is, of course, altogether in favor of the airway. When one considers the flexibility of the air service and its advantages of speed, it is not unreasonable to doubt that there will be much more extension of railroad building in lands well suited to the use

of the newer medium of the airways.

That big types are to have an opportunity to prove their utility in the long haul coastal service between the United States and her southern neighbors was evidenced recently by the christening by Mrs. Herbert Hoover of the *Buenos Aires*, first of a fleet of twelve huge Consolidated Commodore flying boats, purchased by the New York, Rio and Buenos Aires Airline for passenger service to South America. These big monoplanes, with accommodations for 32 passengers, are to follow each other into service at the rate of one a month until the full dozen has been delivered.

Advocates of the large plane contend that, in addition to its economic and safety advantages, it also makes possible greatly increased comfort for the air traveler. The roominess of the Pullman car, the space in which to move around and "stretch one's legs," are lacking even in the largest of our present plane types although the seating is fully as comfortable. But the facilities are equalled or exceeded in the giant types which have been under discussion here, and in them, the air traveler can be as much at his ease as in his office or his home and, at the same time, be eating up the miles at a rate of 120 per hour or better.

DAILY one sees the predictions of the dreamers of the last century coming to practical realization. The British have a tiny plane for the private flyer, having a wing span of only 25 feet and designed to make 80 miles an hour and do 40 miles on a gallon of petrol. The autogiro came down at the National Air Races in a 20-foot circle in an almost perpendicular landing. And now Dr. Dornier and his fellow designers of aerial titans have shown that planes with wing spans in the neighborhood of 200 feet and with enough horsepower to drive a sizable steamship can take off with scores of passengers, rise, maneuver, and fly in a way to put any but the most skillful of the birds to shame.



THE DORNIER FLYING BOAT TAXIING

One of the sponsons or stubs on the side of the hull, used in place of wing-tip floats, shows in this photograph. In this ship the engines are mounted in tandem pairs on the wing

Award of the Scientific American Medal

An Awakened Interest in Sea Safety Has Brought Results

FOR the ninth time the SCIENTIFIC AMERICAN medal has been bestowed and this time for outstanding achievement in the field of marine safety. This medal is donated by the SCIENTIFIC AMERICAN and is awarded by the American Museum of Safety, a non-commercial organization which was the first in the field of safety in this country. The decision was made by a remarkable committee of experts including naval officers of high rank, captains of the Merchant Marine, naval architects, and editors of professional journals.

The Committee met in executive session and after an examination of 80 projects, awarded the SCIENTIFIC AMERICAN Gold Medal to Professor Reginald A. Fessenden "for his various inventions for promoting safety at sea," as the citation denominates. It should be noted that several inven-

tions, all making for sea safety, are involved. We shall go into the subject in greater detail in our next issue, but we cannot resist mentioning here one of his achievements, the fathometer, by which the ability to obtain accurate and frequent soundings and to compare them with the chart, allows a vessel's course and position to be constantly known.

The Committee considered that several other devices were so good as to warrant the citation of three "Honorable Mentions." The first is a device invented by Mr. J. Lyell Wilson, Assistant Chief Surveyor, American Bureau of Shipping, for a stability meter which not only makes for safety of the ship but also assists in the economical operation of the vessel.

The second device to receive honorable mention is an attachment for life boats to insure their passing over obstacles. This is known as a sea "skate"



PROF. REGINALD A. FESSENDEN,
WINNER OF THE COMPETITION

This picture shows Professor Fessenden at work at his laboratory near Boston

The Committee of Award of the Scientific American Medal for Safety at Sea met in executive session on October 16th, 1929, at the National Arts Club, 15 Gramercy Park, New York, and after an examination of the eighty plans submitted decided that the award should be given to:

REGINALD A. FESSENDEN FOR HIS VARIOUS INVENTIONS FOR PROMOTING SAFETY AT SEA.

In witness of this action the members of the Committee have affixed their signatures and the seal of the American Museum of Safety has been impressed.

J. M. R. Winslow, Chairman

Edward J. Fitzgerald Vice Chairman

W. S. Benson

H. H. Brown

T. H. Lyon

C. A. McAllister

A. B. Newell

C. P. Plunkett

Felix Riesenberg

Louis Weickum

A. A. Hopkins, Secretary

CITATION GIVING THE AWARD

This is the formal citation signed by members of the Committee which was made up of naval officers of high rank, marine architects, and engineers, all men of expert knowledge of the sea

and is a demountable detachment which permits a life boat to be launched even with a 46 degree list. This is the invention of A. P. Schat of Utrecht, Holland.

The third device is a folding life raft or net, constructed of balsa wood. This is the invention of Jesse W. Reno of New York City.

REAR-ADMIRAL C. McR. WINSLOW, U. S. N. (Ret.), presided at the meeting. He is well known as a naval officer of the highest type. Two other rear-admirals gave their counsel to the Committee, Rear-Admiral W. S. Benson, U. S. N. (Ret.), Chief of Operations during the World War, and Rear-Admiral C. P. Plunkett, U. S. N. (Ret.), who was Commandant of the Brooklyn Navy Yard until recently. Vice-Ch'm. Captain E. T. Fitzgerald, U. S. N. (Ret.), Board of Transportation, N. Y. City, rendered great assistance in acting as "Judge-Advocate" in explaining the plans. Captains C. A. McAllister, Pres. American Bureau of Shipping; T. H. Lyon, Port Captain, International Mercantile Marine; H. McConkey, Port Captain, Cunard Steamship Co., Ltd.; and Felix Riesenberg, Martin Motors, Inc., gave wise professional advice. The technical press was represented by Messrs. H. H. Brown, Editor, *Marine Engineering and Shipping Age*, A. B. Newell, Editor, *Motor Ship*, and A. A. Hopkins, Assoc. Ed. SCIENTIFIC AMERICAN. Mr. L. Weickum gave valuable assistance on publicity.

Behind the Scenes in Modern Archeology

The Modern Archeologist Is a Scientist and His Science Contains Keen Interest. At Times It Smacks of Adventure. How He Restores and Exhibits Faded Discoveries Made in the Field

By HORACE H. F. JAYNE*

Director, The Museum of the University of Pennsylvania

THE usual conception of the duties of an archeologist involve only wielding a pick and shovel or directing vast groups of men to remove sand dunes lying above hoards of the treasures of antiquity.

Few realize that this forms only a really very small part of an archeologist's responsibilities, and that on the one hand he must have extensive theoretical and practical knowledge before he digs at all, and on the other that he must learn how to preserve and restore in the best possible manner the objects his excavations yield. A trained archeologist knows full well that he is dealing with priceless documents and the evidence which they may hold must by every means be retrieved. It is this that marks the difference between an archeologist and the outlaw "pot-hunter" or the treasure seeker, whose sole concern is to fill a museum case with impressive but generally useless and undocumented specimens.

MUCH of the initial work of cleaning and restoring material is done in the field. An ingenious archeologist even recaptures the form of an object that has totally disintegrated before a spadeful of earth is turned. The substance of a thing may wholly disappear in the course of time and yet leave an imprint of its form in the layer of earth that has carried it. Many readers will remember those casts of human bodies made during the excavations at Pompeii, where plaster was poured into the hollow left after all that was human had disappeared. Never was the ghost of death's agony so vividly materialized: a modern miracle had recaptured the last dreadful moment of a man who perished 1900 years ago.

Another illustration of the value of this technique is to be found in the remarkable feat performed by Mr. Woolley, Director of the Joint Expedition of the Museum of the University of Pennsylvania and the British Museum, at Ur of the Chaldees. [See also page 471 of this issue.—The Editor] As little by little his workers



THE DELICATE STAGE

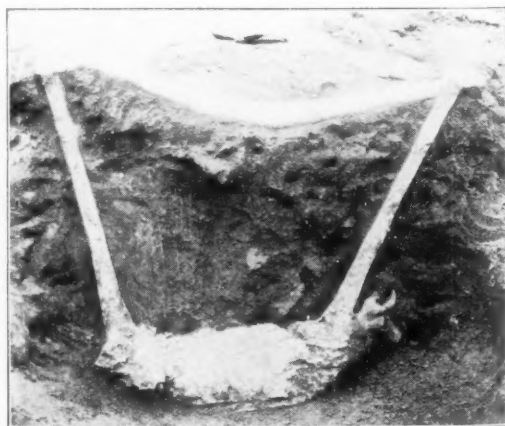
When fragile objects are being revealed, a camel's hair brush is generally used

uncovered the strata of earth above the royal tombs, in the now famous predynastic cemetery, Mr. Woolley noticed a small round hole extending into the earth and a few feet away another hole of the same dimensions and direction. Though unaware of what these represented, his great archeological experience told him that here might be a clue to something vitally important. Halting the work he prepared a "soup" of plaster of Paris and poured it meticulously into the holes until they could hold no more.

After allowing the solution to set, the earth was carefully cleared away around the newly created plaster form, revealing a perfect reproduction of a harp's body and uprights. It had been made of wood

originally but must have long since decayed and only a mould of its shape remained, of which the plaster filled every crevice. Even the seven fine strings of the harp were recaptured in plaster as the illustration shows, and the metal ornaments, originally fastened to the wood frame, were found adhering in their proper places to the new plaster form of the harp. Had Mr. Woolley been a hasty excavator or possessed of a mind less keen and ingenious, this inestimable piece of archeological evidence would have been lost forever.

THESE belong certainly to the more spectacular class of restorations made during the course of excavating, yet virtually every object, as it is unearthed, is subjected to an equally careful treatment. Where fragile skeletal material is to be removed, it is often impregnated with wax to strengthen the weakened structure of the bones. Where the excavator is dealing with anything particularly delicate the spade and pick are of course immediately abandoned, even the coarse whisk broom is laid aside and hands alone are used in the work; when even these are too clumsy, although they have become extremely sensitive by many a day of practice, then recourse is had to a fine camel's hair brush.



CAST OF A SUMERIAN HARP

Made in position by pouring plaster into the hollow left after the wooden frame had wholly disintegrated

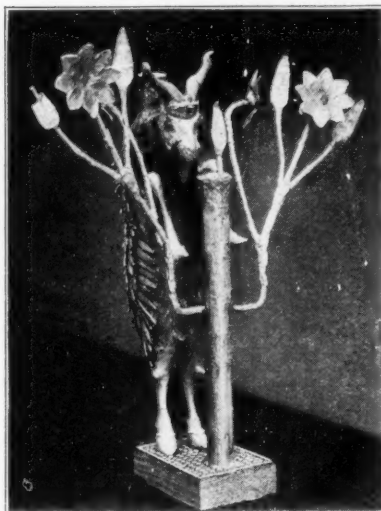
*See "Among Our Contributors," page 469.

Further careful work is carried on also at the actual site where scattered fragments of broken vessels are brought together and the whole rebuilt, and where fragile objects are strengthened and made ready for packing so that they may be safely transported to the museums for which they are destined. Because every object is recognized as a document of unpredictable importance, every effort is made to preserve it intact so that not a bit of historical evidence is lost.

Restoration and repair for which the facilities at the site are insufficient are further pursued when the object reaches the museum. It may often happen that months of treatment are necessary before an object is ready for displaying in a case for the instruction and enjoyment of the public. Those concerned with archeological finds and their uses as a means for education are becoming more conscious of the necessity of presenting these properly to the public. In the past, curators were content to crowd their cases indiscriminately with the various finds sent back by their expeditions. A pottery vessel badly repaired, a heavily corroded metal object, a handful of mixed beads were all considered good enough for the public.

TODAY all this is changed. We have learned that the most casual visitor responds ten times more intelligently to the historical and artistic messages of a vessel so cleverly repaired as to seem almost in its original condition; that he derives more instruction from a thing of metal if it is cleaned and gleams with its original luster or from beads graded and strung as undoubtedly they had been in the past. With the actual installation, care must be taken to avoid the theatrical, but every step that leads to a less crowded setting is one in the right direction.

In short, it is now the duty of museum curators so to display the finds of the archeologists that the messages they bear are as comprehensible and interesting to the public as to the specialist. These documents from the past can thus exert the subtle



GOLD AND SILVER GOAT

Probably the decoration of a harp. Found at Ur and most carefully restored

but invaluable educational force of which they are so richly possessed.

An outstanding example that illustrates well this modern tendency in the conduct of our archeological museums can be seen in the case of the recent finds from the Ur excavations of the joint expedition of the British Museum and the Museum of the University of Pennsylvania. Although on the field all the objects are subjected by Mr. Woolley to the same exacting care we have mentioned in the case of the harp found last season, yet the study and research, the cleaning, repairing, and restoring is carried even further after the objects which fall to the lot of the University Museum arrive in this country.

Before these can be installed in the cases of the Museum's exhibition collections, even before they can be handled by scholars and experts, they must undergo many varied treatments. In the hands of the expert restorer the pottery vessels must have

lacking fragments supplied and colored to harmonize with the original ware; the surface of Babylonian tablets, which are the oldest written documents in existence, must be cleaned with delicate brushes and often baked to preserve them absolutely intact for future scholars to study; the delicate inlaid plaques, parts of which may have become hopelessly confused, must be reassembled and reset—they are the picture puzzles of 5000 years ago; the treasures of countless beads of lapis lazuli, carnelian, agate, and precious metals must be sorted with the utmost care. One of the Museum's staff spent day after day at his work, recreating the delicate headdresses and necklaces, diadems and girdles of the predynastic jewelers.

The metal vessels and objects found at Ur have perhaps presented the most difficult problems. To restore them to their original form and luster, the assistance of the most modern knowledge in physics and chemistry has been required. Professor A. K. Graham of the Physics Department of the University of Pennsylvania, was entrusted with this work. The Royal Tombs of Ur yielded an impressive collection of delicate vessels in gold and weapons and ornaments of silver and electrum, as well as scores in the more commonplace bronze. After 5000 years the weight of the earth upon them had often crushed these fragile objects completely out of shape; moisture had oxidized others so completely that they came from the field as mere shapeless masses of corroded metal. Here were problems indeed for the chemist and physicist.

THE metallurgists of these early times, as Dr. Graham reports, were not able to refine the precious metals perfectly and many impurities necessarily remained in their composition. Particularly is this true of the silver objects from Ur. Often their shape, their decorative detail, their



SILVER OBJECTS BEFORE AND AFTER CLEANING

At the left they are shown as they arrived at the University of Pennsylvania Museum; at the right after the processes described in the text had been applied. One object is an antelope head and the other a bracelet. Several arts contributed to these restorations

quality are completely obscured until they have been subjected to an exacting course of chemical treatment. The earlier methods resulting from the investigations of Dr. Alexander Scott of the British Museum and those developed by Dr. Fink of the Metropolitan Museum were called into play, but even these had to be modified in the case of each individual object, since no general technique was found to apply to all cases.

THE tiny silver head of an antelope shown in one of the illustrations, a minute masterpiece of Sumerian sculpture, is a singularly satisfactory example of the course of treatment necessary, and the happy results. It came to the Museum in the form first shown. The parts which later were discovered to be the antlers surrounded a delicate gold vanity box in the form of a shell. For the rest it was a conglomeration that might yield almost anything. It was subjected first to electrolysis in a bath of weak caustic soda for several days continuously. This was followed by repeated boiling in formic and, little by little, the true shapes began to emerge. What before this treatment had seemed a solid ring fell away from the mass and was revealed as a delicately wrought bracelet of several turns of tapered silver wire. The little head itself, after it came from its succession of baths, was gently brushed and a sharp pick was used under a magnifying glass to remove the loosened crust from the fine lines of decoration. It was then once



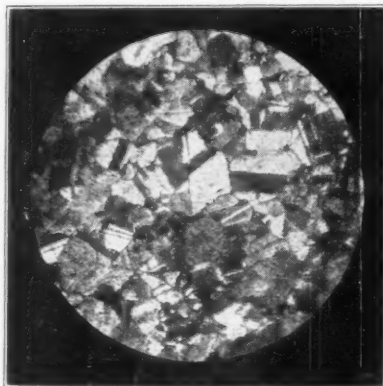
CORRODED BOWL

Before being treated electrolytically and chemically by Professor A. K. Graham

again washed, dried, lacquered, and mounted on a tiny pedestal. Seldom has modern science retrieved so perfectly from the past an object of such pre-eminent artistic beauty and archeological importance.

Another illustration of the worth of all this trouble and the uses of chemical research in the restoration of archeological remains is found in the silver bowl shown in another pair of illustrations. This vessel, with its pleasing lines, had rested in another silver bowl so that a portion of the outer surface was in almost a perfect state of preservation and thus gave a standard to achieve for the rest of the surface which, both inside and out, was

heavily covered, as may be seen in the first figure. The actual process in this instance was not difficult. The bowl responded very well to the electrolytic treatment and after subsequent cleaning and lacquering is in a condition closely approximating, we



THE EVIDENCE

Photomicrograph of minute fragment from a silver vessel at Ur. See the text

may well believe, its original appearance.

In connection with this bowl an unexpected archeological discovery was also made. On one side of the vessel, to the right of the electrum lug shown in the photograph, a marking came to light after the treatment—a conventional bull's leg engraved below the rim. This we now know was the particular "hall mark," unquestionably the earliest yet recorded, of King Meskalam Dug; it has been discovered also on his ceremonial implements and on the gold and silver spear points found with the body-guard buried in his tomb.

It is discoveries like these that repay so handsomely the enormous amount of care and research to which the objects are subjected. The contents of the tomb of King Tutankhamen were in a like manner treated with meticulous care, so that today they are the most perfect examples of ancient Egyptian artistry preserved, even as they are among the richest finds ever credited to archeological science.

THESE metallurgical researches, in connection with the silver vessels found at Ur, were extended even further by Professor Graham, than merely restoring them for exhibition. The very process used in fashioning them was sought by examining the microscopic structure of minute fragments of the metal. A photomicrograph of one of these is reproduced. From this we may safely deduce that a bowl like that shown would have gone through the following stages in its manufacture:

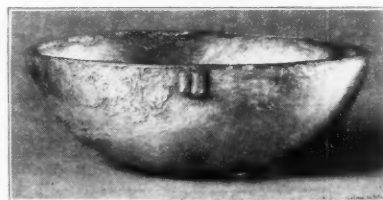
After the native silver was refined and properly alloyed it would be cast

into a convenient form. Then by alternately heating in a furnace and rolling on a flat surface a sheet of desired thickness would be obtained. Next, the Sumerian silversmith would study the form of the vessel to be produced, cut a flat sheet according to the chosen pattern and hammer it over prepared forms to bring it to the shape desired. During this hammering the vessel would have to be annealed—that is, alternately heated and cooled—about three or four times, to keep the metal soft enough to be worked. Finally the surface was burnished and the completed vessel marked with the insignia of the King.

It is the structure of the silver as revealed by the microscope which permits us to be so certain of this process. It is plainly the structure of an annealed metal and the numerous cases of twinning in the crystalline mass indicate a number of previous workings. It is the same method used by the silversmiths of today, the ancestry of whose skill is therefore traced back by these researches at least 5000 years.

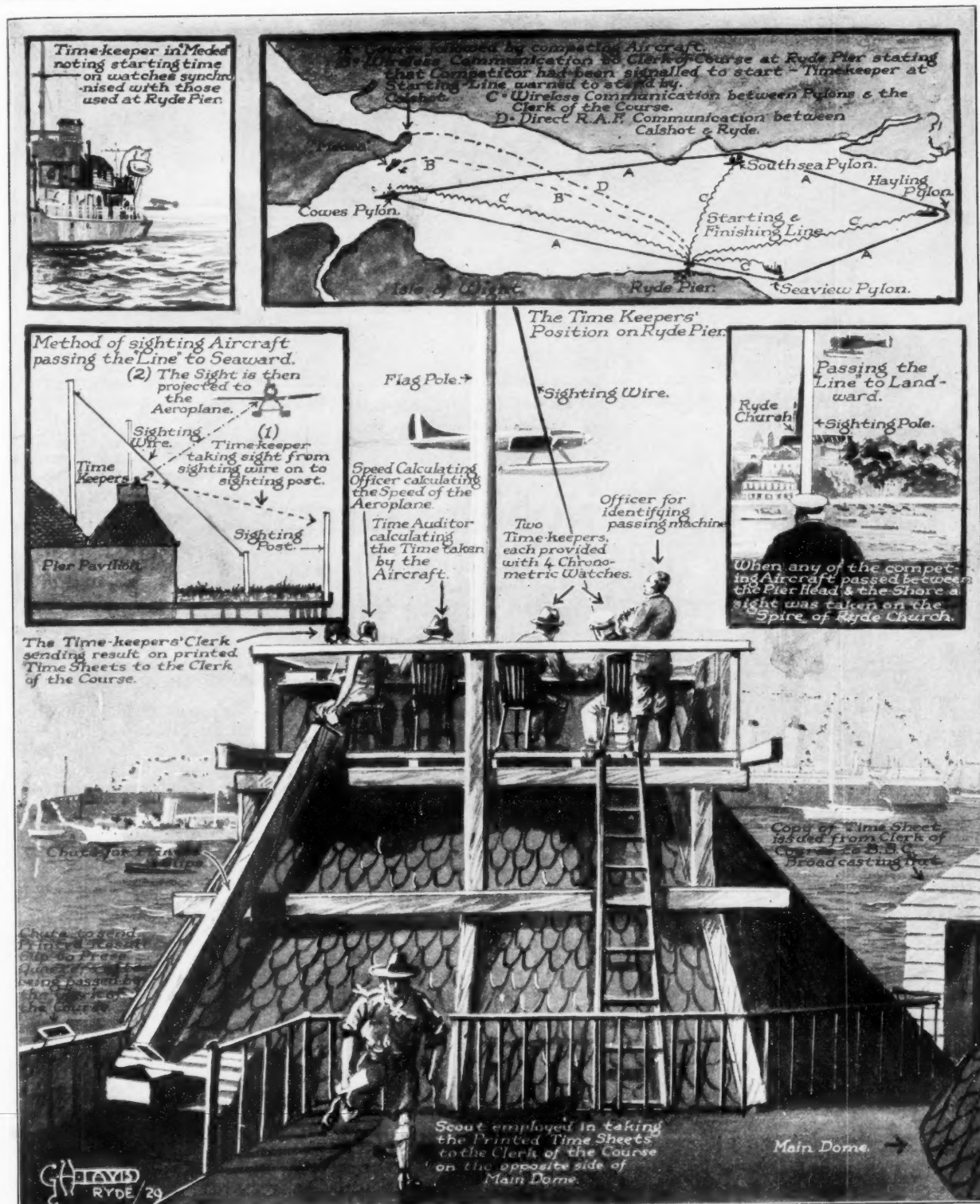
IF we compare the archeology of the past century, concerned only with despoiling the sites of ancient civilization of inscribed monuments and works of art; neglecting, even heedlessly destroying, historical knowledge latent in humble objects of every sort; failing to investigate properly and above all to interpret the objects actually brought back from the field—if we compare this work with that carried on by the archeologists of today, we gain an insight of how very great has been the advance of the science. It is no longer a dry subject, interesting only learned philologists or antiquarians, to be associated with the dusty corridors of the museums of the past; it is now a very vital study, calling to its service men of adventurous natures and long training for the field work, scientists who have specialized in other fields for solving its problems, experts in virtually every walk of life.

The findings of archeology, moreover, are today being so exhibited and interpreted that they have a universal appeal and even the most casual museum visitor is thrilled by the pictures and stories they tell about the customs of long vanished civilizations.



THE SAME BOWL

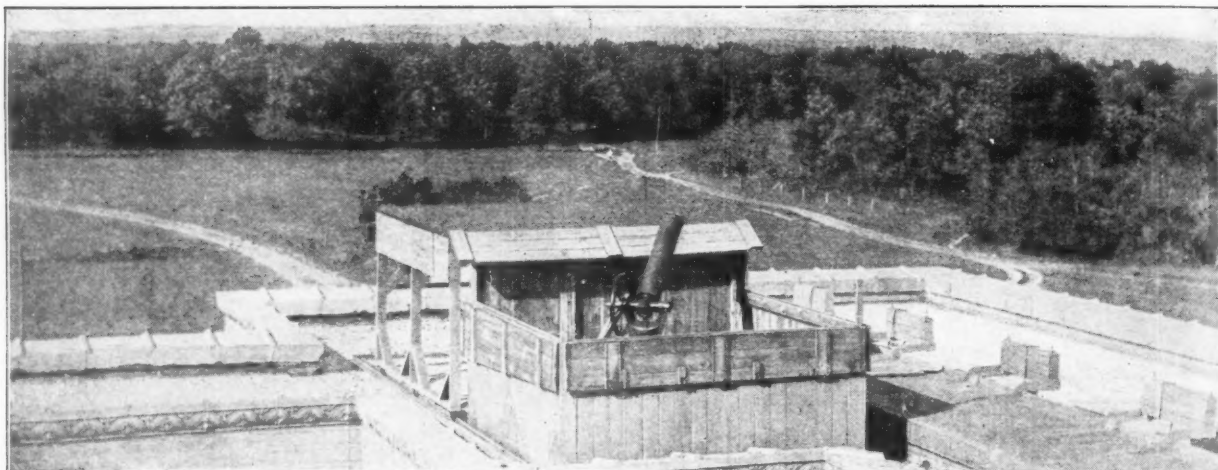
Virtually a perfect restoration. The bull's leg referred to in the text shows faintly



Timing the Schneider Cup Races: Over 300 Miles Per Hour

TWO timekeepers, Colonel Lindsay Lloyd and Mr. A. G. Reynolds, each with four chronometric watches, timed the seaplanes in this year's Schneider Trophy Contest from a platform built atop a dome of a pavilion on Ryde Pier, the starting and stopping point. As gunfire from the *Medea* started each plane, a timekeeper on board informed the Clerk of the Course at Ryde Pier by wireless, and he informed the timekeepers at the starting line.

These sighted the plane against a wire if it passed to seaward and on the spire of Ryde Church if it passed to landward, and "split" their stop watches so there was a double check on the time. As the machine completed its lap, the time was noted and given to an auditor who worked out the elapsed time and passed his calculations on to a calculator who worked out the plane's speed. The results were then passed down a chute to the Clerk of the Course.



Courtesy Yerkes Observatory

A SPECIAL COMET-SEEKING TELESCOPE ON THE ROOF OF YERKES OBSERVATORY

It has a hand wheel which facilitates sweeping the skies. A diagonal mirror within directs the rays into a fixed, comfortable eyepiece

in the horizontal axis. The special qualities are great light gathering power (large objective) with short focal length and low magnification

The Puzzles of the Comets—II

Research Indicates That the Sun Picked Up Its Family of Comets Only Recently While Passing Through Orion

By HENRY NORRIS RUSSELL, Ph.D.

*Director of the Observatory and Chairman of the Department of Astronomy at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington*

WE told last month of some of the problems, solved or still awaiting an answer, which comets present to the astronomer. But the tale is too long for a page or two and there is more worth the telling.

Comets are members of our solar system, or at least this is true of all those which have been accurately enough observed to settle the question. In a few cases the velocity of the comet when under observation near the sun was greater than the maximum value for a body moving in even the longest elliptic orbit and returning regularly to the sun. But in every one of these cases calculations of the attraction of the planets showed that they had speeded up the comet as it approached the sun and that, when well outside Neptune's orbit, its speed was below the critical limit or at most exceeded it by less than the errors of observation. The comets which we see are therefore old timers and not newcomers, although some of them have lingered long in the outer darkness.

Delavan's Comet of 1914 is a good example. Making allowance for the fact that it never came very near the sun, and was unusually remote from the earth, this was the greatest comet of recent times. But the time when last it came home to the sun was far from recent—about 11,000,000 years ago according to Van Biesbroeck's care-

ful calculations. To predict such an enormous interval from the motion shown by a couple of years' observations is obviously possible only if the latter are very precise, and even so there is an uncertainty of a couple of millions of years in the date of the last return.

But this is an extreme case. This comet at its remotest must have been about $1\frac{1}{2}$ light years distant from the sun, and if it had gone much farther the attraction of some other star might have taken it away from our system. But one must not think of it as slipping away from the sun's control to swing into that of the star and pass close to it as it did once near the sun.

FOR the comet, although far from the sun and gradually going farther, would still share the sun's motion through space. Could a remote observer see it as well as the sun he would observe the two traveling in almost parallel paths, traversing a light year's distance in 15,000 years of time (by our earthly reckoning) and separating from one another by only $1/200$ of a light year in that interval. It would be obvious that there was some relation between the two bodies.

But while the comet's motion, compared with that of the sun, is so slow, its motion relative to any other star would be rapid, for these stars have motions of their own quite differ-

ent from the sun's. Should the comet escape from the sun's sphere of influence it would be very little deflected from a straight course by the attraction of any other star, unless by chance it happened to be moving almost directly toward it. Such a close approach would not happen on the average until billions of years and even more had elapsed. For all this time the escaped comet would be a lonely wanderer in the depths of interstellar space—cold, dark, and invisible.

Such a fate as this may befall a comet in another way. At some perihelion passage it may be speeded up by the attraction of the planets until it exceeds the velocity of escape, and not slowed up on its departure enough to undo the damage. It will then set out on an independent career without any help from the attraction of the stars and become a homeless vagabond.

Our solar system must therefore be steadily losing its comets, for the escape process is irreversible; it can happen but once to a given comet and the chance of recruiting the sun's diminishing army by picking up a comet which comes in from interstellar space and is slowed down by planetary attraction is quite negligible.

There are still thousands of comets in our system; probably hundreds of thousands, for the evidence indicates that at least a thousand approach the sun every century (allowing for more than

escape discovery) and very many centuries will elapse before the majority of these will return. A few millions of years ago there must have been even more comets. Can we carry this reckoning back over the 4,000,000,000 years or so since the birth of the planets? If so, was the whole sky full of comets then?

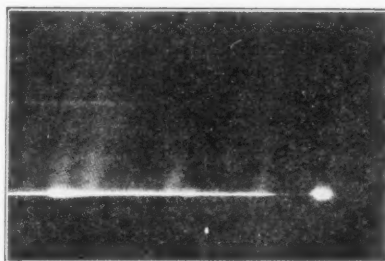
If we attempt to answer these questions we must recall that the danger that a comet may be flung off into space by planetary perturbations is not the only one which besets it. Comets, even if they remain within our system indefinitely, are subject to steady depletion of their own substance by the very processes which make them conspicuous. The greater show a comet makes, the faster it is wasting away, for the gas and dust which is ejected from the nucleus to form the head and is swept away by radiation pressure to create the tail never returns. We have direct photographic evidence that the tail particles move faster and faster the farther they go. The tail fades out at the end not because the gases have stopped shining but only because they are spread out so widely that the light no longer affects the eye or the photographic plate. Each molecule or dust speck must fly on and on at speeds which are by this time much higher than those of the stars in their courses, and become lost in the depths of space, never to return.

If we could watch a comet long enough we might then expect to see it gradually wear itself out, grow a smaller and smaller tail at each return, fade away into a mere spot of hazy light, until at last perhaps even this vanished.

Measured by human chronology this process must be slow, for so far as we can judge by the evidence of the old chronicles, Halley's Comet has not lost much in brightness during the past 2000 years. But we do not have to wait to watch things happen to individual comets. There are numerous short-period comets which return to perihelion every six or eight years. These should be the spendthrifts and might be nearly worn out. As a matter of fact, not one of these comets is conspicuous and many of them seem already to have lost most if not all of their tail-forming material. One, at least, Biela's Comet, which was an easy telescopic object a century or so ago, has faded out altogether and is now quite lost, although it has returned more than once to positions where it would have been conspicuous if it had been as bright as it used to be. Among comets of the same age and year, those with short periods should wear out the fastest, while those which engage but rarely in the brilliant dissipation of a perihelion passage should be less exhausted.

A test of this has recently been made by Bobrovnikoff, a Russian astronomer now at the Lick Observatory. He has collected from various sources determinations of the brightness of 94 comets of known period, ranging from three years to several millions. Plotting these against the periods, he finds that, although the individual values scatter a good deal, the averages show a definite and unquestionable trend. The comets with long periods average the brightest and those of shortest period the faintest. This agrees so well with the results of the theory of gradual disintegration that it would almost prove it independently of the visible arguments already mentioned, and the combined evidence of the two arguments is conclusive.

It appears, therefore, that in bygone ages the comets of our system were not merely more numerous but brighter. How rapid the process of decay is we can not be sure. Only two comets have been observed for a large number of returns, Halley's and Encke's. The first is still a fairly bright comet, although far inferior to many of those of really long period. The second is a faint object and appears to have faded by about a magnitude during the last century; that is, 30 returns. Whether a similar change has happened to Halley's Comet can hardly be determined from the rough estimates of the



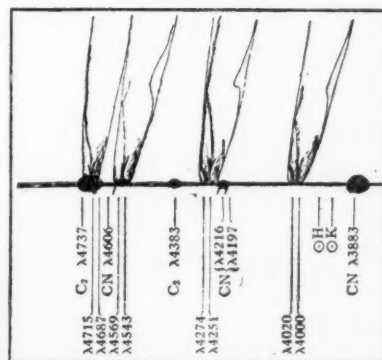
ancient records. Such as they are they indicate a slower decrease in brightness per return.

Even if the rate of disintegration is only one tenth as great as Encke's Comet suggests, a comet must lose about 1/300 of its luminous material at each return. As it dwindles away, the rate of loss itself should decrease, but nevertheless after 3000 returns the brightness should have diminished by ten magnitudes; which covers almost the whole range from the brightest to the faintest on record. This would make the whole life of Encke's Comet about 10,000 years and of Halley's a quarter of a million. Some of the greatest known comets, such as those of 1858 and 1811, have periods of less than 3000 years. On our tentative assumption they would fade away into insignificance in 10,000,000 years. This is a long time from most standpoints, but to the astronomer and even the

geologist it is nothing at all. Our earth is certainly more than 100 times older than this.

Hence either the rate of disintegration of comets is hundreds of times slower than is indicated by such observations as exist, or else the comets which are at present in our system are far younger than the planets and have been added to the system long after the planets were established. Which alternative must we choose?

Bobrovnikoff decides definitely for the second alternative and concludes that our present comets were picked up by the solar system in some way only a few millions of years ago. Some six million or eight million years in the past our sun and its attendant planets must have passed through the great scattered cluster of hot stars which forms the constellation Orion and probably through some of the clouds of nebulosity which accompany them. In traversing such masses of diffuse matter, the combined attraction of the sun and planets might "capture" some of



Courtesy Publications of the Astronomical Society of the Pacific

SPECTRUM OF HALLEY'S COMET

At left is the spectrogram and, above, a diagram of it. Vertical streamers are open slit spectral images of the tail. Figures show wavelengths. Cyanogen (CN) bands are in the head but not the tail. From a paper by Bobrovnikoff

the nebular material and cause it to circulate in orbits about the sun. Such aggregations of matter might well be the parents of comets. In the ages since, those of short period would for the most part fade out, leaving those whose periods were long and a few of the shorter period resulting from secondary changes in their orbits at later dates in their careers.

The result million of years later might be a cometary system roughly resembling ours. Whether the resemblance would be satisfactory in detail can not be settled until a good deal more work has been done, especially in the way of calculating whether comets picked up in this way would ultimately be spread about the sun almost uniformly in all directions as the comets actually are. But in any event the hypothesis is stimulating and its further developments will be awaited with much interest.

Radio in 1930

Regardless of New Circuits, Tubes, and the Like, the Final Test of a Set Is Its Tone Quality

By HOWARD T. CERVANTES*

EACH radio season is ushered in with a new collection of terms and catch-phrases to intrigue the prospective radio-set purchaser. While it would appear from a glance at the radio advertising that there had been a great many startling developments, it frequently becomes apparent after the season is well under way that there have been only one or two important innovations.

This season we are confronted with such terms as "screen-grid," "linear detection," "band pass filter," and countless other terms and phrases which hold no meaning for the layman.

THE layman considering the purchase of a new radio set is confronted with a bewildering array of claims made by various manufacturers regarding the outstanding features of their particular receivers. How is he to select the one which will give him the greatest satisfaction? In the accompanying survey of the situation, the author points out the standardization that has come about in the radio field, and plainly indicates that the choice is largely a matter of the price that one can afford to pay, and the style of "furniture" that one desires to surround his set. One's taste in tone will indicate the set in any price class that will please the purchaser.

—The Editor.

After all, the final test of any radio receiver is what comes out of the loud-speaker. The average man, when he comes to select a radio set, judges it more on this basis than on anything that he has heard or read concerning it. In many instances he requires a private demonstration of the set in his own home where he can operate it under actual working conditions in the location where it is to be used. If the quality of reception does not come up to his expectations, the mere fact that the set uses screen-grid tubes or has linear detection or any other feature will not induce him to buy.

IN reviewing this season's radio sets, we find that the greatest strides have been made in the improved quality of tone and fidelity of reproduction. In fact, a point has been reached where it is a difficult matter to note any marked difference in the reproduction of sets ranging in the same price class. In this respect it would be interesting to witness a radio blind-fold test, using a dozen or so of the leading radio sets of different manufacture similarly priced. It is safe to predict that the result of such a test would show that the majority of people who are incapable of splitting hairs on musical harmonics, and to whom overtones and undertones go unnoticed, would be unable to make an honest distinction between them.

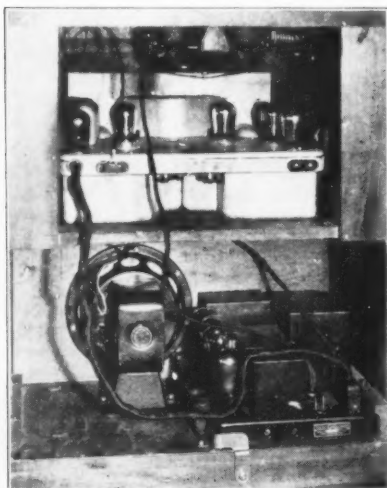
While the great majority of manufacturers are featuring sets using screen-grid tubes, not all of the improved tone quality can be attri-

buted to the use of this new tube. A power tube which has recently come into use, and the progress that has been made in dynamic speaker design, have contributed largely to the better reproduction evident in this year's receivers.

SOME credit must also be given to the broadcasting stations for their higher quality of transmission which has reached a state of perfection undreamed of a few years ago.

Although the present furore over the screen-grid tube would seem to indicate that its application has revolutionized radio over night, we have two prominent manufacturers who are continuing to use the standard type of A. C. tube in their latest productions.

The Victor Talking Machine Company is featuring "micro-synchronous" reception in its latest models. This term is derived from the method



VICTOR

Above: Exterior of the R-52 radio set only.
Below: Interior view of the RE-45 combination radio and electric phonograph



ZENITH

The remote-control unit is shown. A built-in loop aerial and electric phonograph pick-up connection are incorporated

employed for securing resonance between various circuits, which, it is claimed, insures a high degree of sensitivity and selectivity. The tuning arrangement used in these sets is quite unusual, consisting of a lever which operates over a full-vision illuminated scale. A space is provided at the top of this scale for marking in station locations. Close adjustment is secured by turning a small knob at the end of this lever.

Another interesting feature of the Victor sets is the "harmonic modulator,"

*Vice-President, Haynes-Griffin, Inc., New York City

a device for regulating the degree of emphasis to suit the acoustics of the particular room in which the set is located. The Victor company is one of the prominent manufacturers previously mentioned who have not gone in for screen-grid tubes.

We find another notable exception to the use of screen-grid tubes in the new Majestic sets. It will be remembered that last year's Majestic models met with unprecedented success due, in the main, to the fact that this was the first time that a low-priced, high-quality receiver using a built-in dynamic speaker was offered to the public. Several minor changes have been made in the new Majestic sets and they are claimed to exceed in sensitivity, selectivity, and tone quality the models of the previous year. Improvements have also been made in the Majestic dynamic loudspeaker. The entire elimination of hum is another feature being stressed by the manufacturer of these sets.

THE one indisputable fact regarding this year's models is that the purchaser is given greater value for his money than at any time in the past. Any number of manufacturers are marketing sets in console cabinets with dynamic speaker and screen-grid tubes, together with other improvements, priced around 150 dollars. When we get above this figure we find more elaborate cabinets, automatic tuning, remote control, and other features that increase the manufacturer's cost of production. This cost is finally passed along to those who are more exacting in their tastes and requirements. For example, the "tired business man"

will have one of the new remote-control receivers which he may adjust without leaving his easy chair, or he may have the control box on a table beside his bed, enabling him to start, stop, or tune the set without getting up. For that matter, the control box may be installed in any room in the house and the radio set proper located in any other room desired.

We have a set embodying this feature in the latest model by Kolster. This set is furnished with a long cable at the end of which is a small control box resembling very much the push-button type of control for intercommunicating telephones. Ten push buttons are provided on the top of this box, one to start, one to stop, and eight others which, when pressed, operate the mechanism which tunes in the desired station. When the "start" button is pressed, a small red pilot light indicates that the set is functioning. When any of the selector buttons are pressed, a green light shows, indicating that the station



COLONIAL

Model 32, shown with the "secret" panel opened to disclose the control panel



COLONIAL CHASSIS

The Cutting dynamic speaker is shown mounted with the opening pointing down

selected is being tuned in. A small knob is also provided for regulating the volume of the loudspeaker.

Zenith is also marketing a new set with remote-control features. It is possible, with this set, to use several control stations located in various parts of the home. For example, one of these controls may be installed in the bedroom, another in the dining room, and perhaps one in the den. The radio set may be located in another room, or if it is desired, it may be concealed in a closet. Adjustment of the set is accomplished from any of the points at which the control stations are located.

In addition to the remote-control receiver, Zenith is continuing to produce a line of improved automatic receivers superseding those which proved so popular last year. Screen-grid tubes and other new developments in receiver design have been incorporated in these new sets. Push buttons are furnished in addition to the usual

tuning dial and it is only necessary to press one of these buttons to tune in any desired program. If the operator desires to tune in stations other than those that have been set for automatic tuning, he uses the conventional type of tuning dial which is also included in this set.

Another development designed to facilitate adjustment is that of visual tuning employed in the new Stromberg-Carlson Model 846. Visual tuning is accomplished by means of a small meter located on the panel above the main tuning dial. A pointer moves across the face of this meter when the dial knob is rotated. The proper point of adjustment is indicated for any particular station when the pointer is at maximum deflection on the dial scale.

A FEATURE in connection with this method of tuning is what is known as a "silent" knob, which, when depressed, disconnects the loudspeaker while the tuning dial is being rotated. The pressure on the knob is released when the desired number on the dial is reached and the pointer is at maximum deflection. This permits the operator to tune by sight rather than by ear and does away with the necessity of listening to annoying noises and "blasting" of other stations while the dial is being rotated.

Another feature of this set worthy of mention is the fact that the circuit employed compensates for any variation in signal strength and results in uniform volume almost regardless of fading effects.



STROMBERG-CARLSON

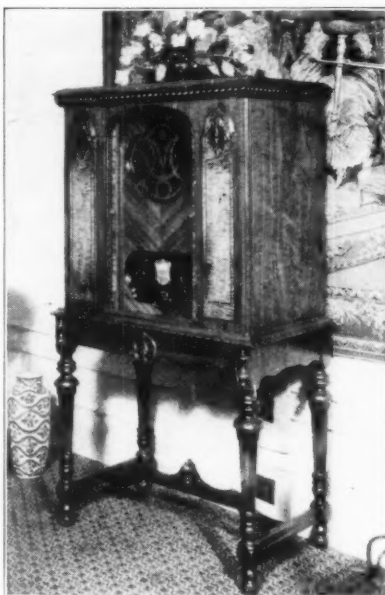
The automatic control in this Model 846 tends to overcome the effects of fading

The new Atwater Kent models are characterized, as in the past, by their compactness and low price. Two new models have been introduced using the screen-grid tubes. The Model 55 employs two of these tubes and the Model 60 three. The Model 60 is intended for use in locations where it is necessary to depend on reception from distant stations. This accounts for the additional tube which makes for greater sensitivity. An Atwater Kent set for use in D. C. districts, using the screen-grid tubes, is also available. All of these sets are equipped with a local-distance switch. The function of this switch when in one position is to cut down sensitivity for local reception and when in the other position to increase sensitivity for distance reception.

THE Atwater Kent company has this year designated several cabinet companies to manufacture consoles expressly for the Atwater Kent chassis and dynamic speaker. This arrangement has resulted in a varied and attractive line of cabinets, making it a simple matter to select a console in proper taste with the style of the furniture in the particular room where the set is to be located.

In the new Colonial sets emphasis is being laid on the Cutting dynamic speaker. Colonial has departed from the usual custom of mounting a loudspeaker on the front panel of the cabinet and has located the speaker at the base so that the sound comes from the bottom of the cabinet. This method is claimed to be much more satisfactory and is likened to indirect lighting, in that the sound is not thrown directly out, but is reflected from the floor in the same way that light is reflected from the ceiling. It is said that a greater realism of tone is obtained with this system.

Locating the speaker at the base of the cabinet has made it possible to do away with the necessity of a speaker grill on the front of the cabinet. No



ATWATER KENT

The sensitive and selective Model 60 in a special cabinet with built-in loudspeaker

doors are in evidence on the Colonial sets, the tuning controls being accessible when a small panel, pressed at one end, raises up and slides into the cabinet out of sight. Screen-grid tubes are used in all of the new Colonial models.

There is no question but that the average unit price on the complete set has been dropping rapidly during the past two years and probably the outstanding price development in manufacturers' merchandising plans for the present year is the large number of sets retailing between 100 dollars and 150 dollars. The majority of these sets are built in small consoles, many of them using the screen-grid tube and all equipped with dynamic speakers.

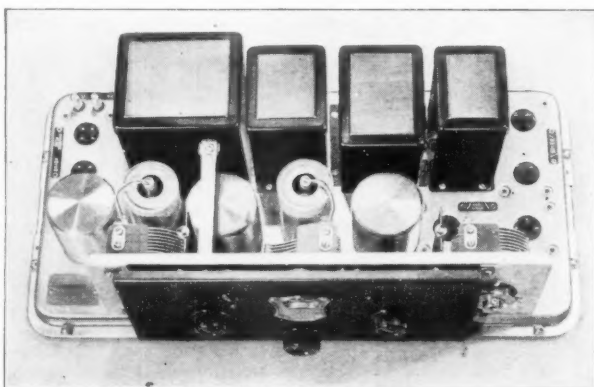
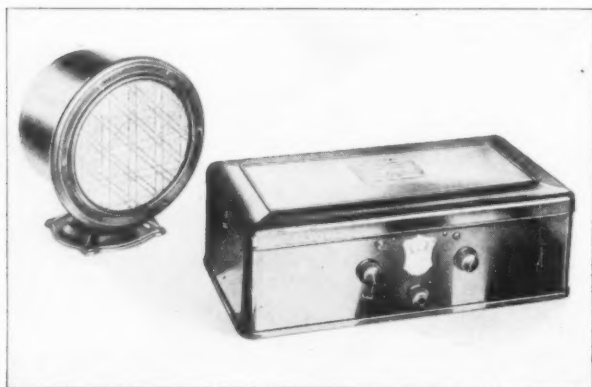
There are probably 15 or more manufacturers fighting tooth and nail in this highly competitive price class. Obviously large volume is necessary to build profitably at this price and it is

equally true that not all of these manufacturers can by any means secure the volume of sales which is necessary. Consequently, several of these manufacturers will probably retire from the field this year or be obliged to seek mergers with their competitors. Evidence of this latter development is already at hand. Some mergers have already been accomplished and radio trade papers are filled with rumors of many more.

Coming into the field this year in a big way, as manufacturers of complete radio sets, are several companies which have heretofore made products which were accessories to the battery set. We find the National Carbon Company in the field with a complete line of Eveready electric receivers, and the Philadelphia Diamond Battery Company with the Philco line of radio sets. The American Bosch Magneto Company is also making a strong play in the medium-price field.

AS indicated in the early part of this article, manufacturers are striving desperately to create the impression that the new models are a distinct advance over sets that have been heretofore available. It is true, nevertheless, that for the first time in radio history it is difficult for the average listener to distinguish between the new sets and those that were available a year ago. This is the best evidence of the stabilization that is making itself evident in the radio industry and purchasers of well-designed sets manufactured in 1928 are today practically as well off as the owner of any of the latest models.

Whereas hundreds of thousands of electric sets were sold last year, it is generally believed that the big swing from battery sets to electric sets will take place in 1930 and that consequently more dollars per capita will be spent by the public for radio in the next six months than in any corresponding period in the history of the art.

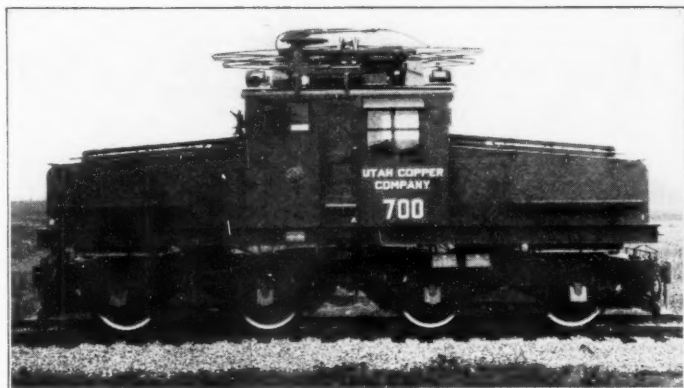


TWO OTHER MODELS

The Atwater Kent Model 60, shown in a cabinet at the top of the page, is illustrated in a table model at the left above. At the right

is an interior view of the Model 55 showing the arrangement of the parts. Note the screen-grid tubes in their metal shield cans

Largest Electrified Metal Mine



COMBINATION TROLLEY-BATTERY LOCOMOTIVE

Seventy-five ton electric locomotive designed for operation either from a trolley at 750 volts or from a 230-volt storage battery. Note folded trolley



WITH A TRAIN OF COPPER ORE

Front view of the first of the special locomotives drawing power from a trolley wire and pulling a heavy load

THE Bingham, Utah, mining properties of the Utah Copper Company can now claim the distinction of being the world's largest electrified metal mine. The electrification of the haulage system of this mine, starting on a large scale early in 1928, has now progressed to a point where the electric equipment involved is the most complete and up-to-date of any metal mining project.

Although the actual mining operations had already been electrified, the haulage system had, up to the middle of 1928, been of the steam type. A trial locomotive was built by the General Electric Company and was found satisfactory in service. Plans were then made for the installation of 20, more than half of which are now in service, and finally, for an additional 20 for use as soon as they can be built and delivered. It is expected that possibly a few in addition to this number will be required to complete the haulage program. Thus this mine will have in use by far the largest number of electric locomotives ever applied to an open-cut mining operation.

The copper ore is found on both sides of the canyon in which the town of Bingham is situated. Giant electric shovels working on successive terraces cut in the mountain face, remove the overburden which covers the ore, and then the ore itself. The overburden is deposited in cars which are hauled away by the electric locomotives and dumped

down another side of the mountain, while the ore itself is hauled in cars to the mills at Magna, 17 miles distant.

All the locomotives are specially designed for this service and weigh 75 tons each. Seven of the 41 involved are a combination type particularly valuable for operation where power cannot always be obtained from the usual overhead system. Each unit has facilities for overhead collection of current, side-arm collection, or for operation



THE COMPANY'S RAILROAD

Portion of the Utah Copper Company's railroad, showing the town. In the center background is a large inclined cable elevator



Photograph Courtesy General Electric Company

LONGEST TOWN IN THE WORLD

Bingham, Utah, reputed to be the longest of its size in the world, consists of a single street in a valley. Terraced hillside is the mine

by means of storage batteries. In addition, the 41 locomotives are each equipped with a cable reel collector by means of which power can be delivered to the locomotive over a considerable distance from the supply point by means of a trailing cable.

Power for this haulage system will be supplied from a number of substations, two of which are already in use, and an extensive electrification system is necessary for distributing the power. The electric locomotives haul the ore cars up the side of the mountain by means of switchbacks over the various benches to the shovels. There the cars are loaded and hauled back down to the foot of the mountain, where they are made up into long trains and transported to the mill over the Bingham and Garfield Railroad.

Four large totally-enclosed motors, controlled by a single-unit, three-speed system, drive each locomotive.

From the Archeologist's Notebook

Scythian Bronzes

THE Scythians were a group of war-like Iranian tribes mixed with Mongolians that over-ran southern Russia and southern Siberia. Greek influence was not able to kill the virile Scythian style which, even when



SCYTHIAN SILVER RAMS

Owing to plundering, articles of Scythian origin in gold and silver are rarely found

elaborated, remains purely Asiatic. The problem of the Scythian bronzes is a very difficult one and museums seek eagerly for them. The Metropolitan Museum of Art has many examples of them dating from the 3rd and 4th Century A.D. We illustrate two of them, first, a kneeling deer in bronze and second a pair of rams kneeling on a little cart. Both rams and cart are of silver which, like gold, is rare among the "Scythian" finds which came from China and Siberia because of early and thorough plundering. The significance of the kneeling animals is not clear but it has been suggested that they represent animals already slaughtered and ready for the sacrifices. Archeology affords endless opportunities for study.

Primitive Art Solves the Secrets of Food Distribution

SCIENTISTS are solving the problem of when and where various food plants were first cultivated. The origin of many is now definitely known, according to researchers on the staff of the Field Museum of Natural History; others are still in dispute. How some of these problems are solved is illustrated by exhibits at Field Museum. For example, in the last few years scientists have established, through the unearthing of some very ancient pottery on the coast of Peru, that certain plants are indigenous to the American continents, and not the result of importation by the European settlers. These pots, made many centuries before the discovery of America by the white man, are modeled in the shapes of various plants, and thus prove that those plants were grown on this side of the world in those early

days, according to Dr. William M. McGovern, former assistant curator of South American and Mexican ethnology at the museum.

Among the plants which the Field Museum collection proves are indigenous to America are peanuts, maize, squashes, pumpkins, beans, potatoes, and the poisonous tuber called mandioka from which tapioca is made. All of these have been used as models for the shape or the decorations of the pottery. From other sources, it is known that pineapples, tobacco, tomatoes, chocolate, and coca from which cocaine is made, originated in the Americas. On the other hand, watermelon, believed by most people to be a 100 percent American product of our southern states, apparently originated thousands of years ago in Africa, says Dr. McGovern, for remains of watermelons and their seeds have been discovered in tombs of ancient Egypt.

The "False Pyramid" of Medum

THE Museum of the University of Pennsylvania has received permission from the Egyptian Government to carry on archeological work at Medum in Egypt and has organized an expedition which began excavation on that site in November. The expedition will be under the leadership of Alan Rowe, says Director Jayne, and will be conducted under the auspices of



POTATO-SHAPED POTTERY

Archeology helps to clear up the true origins of food plants in foreign climes

the Eckley Brinton Coxe, Jr. Foundation, which was established for the support of the Egyptian Section of the University Museum and for the furtherance of field work in Egypt. Mr. Rowe has been serving since 1925 as field director of the University Museum's expedition to Beisan in Palestine. With the organization of the new Egyptian expedition, however, the work at Beisan in which the museum has been engaged for seven years will be temporarily suspended.

Medum lies in the Libyan desert, roughly between the northern end of the Fayyum and the River Nile, some 50-odd miles south of Cairo, and is a site which offers great possibilities not only for fresh contributions to existing knowledge in Egyptian research but also for the collection of interesting and valuable material. To the north of Medum and in the following order



A KNEELING BRONZE DEER

An example of Scythian art in bronze dating from the 3rd or 4th Century A. D.

from south to north lie the Ancient and Middle Empire pyramid sites of Lisht, Dahshur, Sakkara, Abusir, Zawiet-el-Aryan, Gizah, and Abu Roash, while to the south are the Middle Empire pyramid sites of Illahun and Hawara. All these sites really form one continuous royal cemetery nearly 60 miles in length on the western side of the Nile.

In its work at Medum, which is believed to be chiefly a Fourth Dynasty site dating onwards from about 2930 B.C., the University Museum expedition will concentrate on the excavation of a pyramid called by the Arabs "El-Haram el-Kaddab," or the "false pyramid," and described in a report from Mr. Rowe as the most important structure visible on the site.

"The 'false pyramid,'" Mr. Rowe's report states, "is of three, originally seven, square receding stories which, according to Professor George Steindorff, of Leipzig, rise to a height of 214 feet 8 inches in steep stages. The first story is 81 feet 6 inches high, the second 98 feet 11 inches, and the third, now almost destroyed, is 34 feet 3 inches high.

"Professor W. M. Flinders Petrie, of the British School of Archeology, points out that the pyramid was built cumulatively, 'that is to say, in seven successive coats each of which bore a finished dressed face' around a central mastabah tomb. He states that the stepped stories were originally filled out."

Early Man in North Arabia

By HENRY FIELD

Leader of the Captain Marshall Field North Arabian Desert Expedition

THE Captain Marshall Field North Arabian Desert Expedition, under the leadership of the writer (assistant curator of the Field Museum of Natural History, Chicago), covered thousands of miles between Bagdad and the Hejaz railway in search of archeological information. Many thousands of years ago this desert was fertile and well watered and able to support a semi-nomadic population. Thousands of flint implements, scattered over the desert, prove the existence of primitive man in various prehistoric phases of culture.

The two photographs show fortresses built by Roman legions for protection from Bedouin marauders. Qasr Azrak was visited by the expedition to make plans, drawings, and photographs of the buildings. The upper photograph shows myself directing the work of removing a door-lintel inscribed in Greek characters, which may give the date of the Roman occupation of Qasr Burqa, the most eastern outpost of the Roman Empire. Qasr Burqa stands today more than 100 miles from wells containing water, although in the rainy season there is often water in the reservoir built by the Roman legions. Much valuable archeological data was collected; thousands of photographs of the various sites visited, and of the modern Bedouins, were obtained. In fact a whole new light has been thrown on the early history of the North Arabian desert, and the results suggest that this area may have lain, in prehistoric times, on one of the main lines of migration between east and west.

It is now possible to state with absolute certainty that man in a prehistoric phase of culture inhabited this North Arabian or Syrian Desert over a long period of time.



HENRY FIELD AND PARTY EXPLORING QASR AZRAK

Removing a lintel inscribed in Greek characters from a building which was located at the most eastern outpost of the Roman Empire. North Arabia, once fertile, is now a desert

Marble Sculpture and the Ultra-violet Ray

THE invisible ultra-violet rays are at the cold end of the solar spectrum. When objects are exposed to this light they tend in varying degrees either to fluoresce or to reflect the rays. In the case of fluorescence, substances which under normal conditions are white might appear yellow, blue, or any other color when exposed to ultra-violet light.

Perhaps no works of art through the ages have been so sought for and cherished as fine marble sculptures. The temptation to produce forgeries, to copy, or to repair has attracted skilful artists and artisans. For this reason, in the study of the physical characteristics of museum exhibits, no material seemed to offer more interesting possibilities than marble.

With continued exposure to the elements, the surface of marble is changed, and gradually, because of penetration from the surface, chemical action proceeds a short distance into

the body of the marble. We might, therefore, expect that the appearance of old marble under the ultra-violet ray would be different from that of freshly cut marble (or old marble which has been re-cut), the surface of which has not been changed by chemical action, and this, in fact, has been demonstrated by experiments.

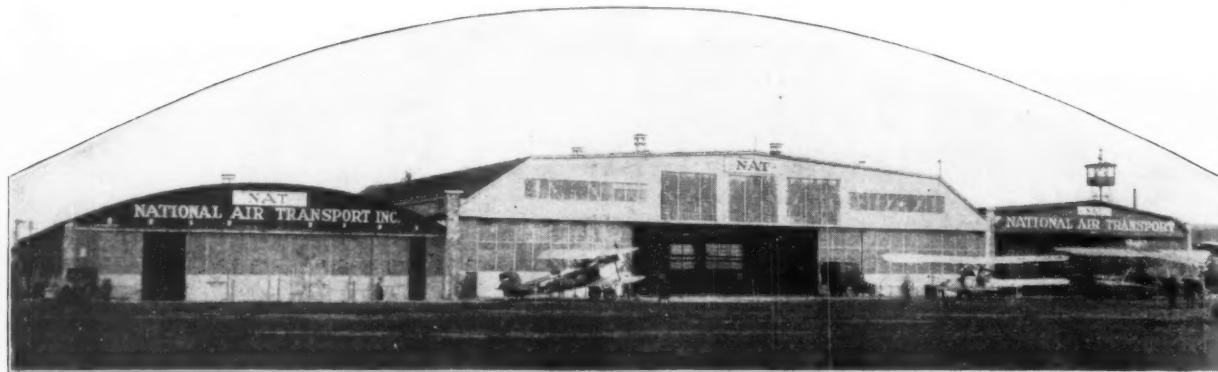
After additional preliminary experimental work with marbles of various periods, a group of test examples was submitted. In all cases the conclusions based on the use of the ultra-violet light were identical with those which had already been reached either on external evidence or by reasons of style. Both old and new pieces were submitted without any information whatsoever concerning the age of the specimens. Examined under the ultra-violet rays, the genuine pieces were readily distinguished from those which were more modern than they purported to be. The Little Maiden by Dossena, a marble statuette in the archaistic Roman style (see the SCIENTIFIC AMERICAN for October, 1929), although its surface had been altered by baking the marble and then pitting it with a ragged stone, was shown by the test to have been made from recently cut marble. In addition, the three portions into which the sculpture had been broken were found to be part of the same piece of marble.

As with all new things, possibilities of which have not been thoroughly probed, it may be supposed that the ultra-violet light will be a panacea for all troubles. But just as with the X ray, it requires a wide experience with varying cases, and no less careful judgment. Our experiments show that the ultra-violet rays will be of very great assistance in establishing the age of marble. That the ultra-violet rays have possibilities which are not limited to this field alone we are learning from our studies.—James J. Rorimer, of the Staff of the Metropolitan Museum of Art.



AN ANCIENT ROMAN STRONGHOLD

The fortress of Qasr Azrak was built by Roman legions to defend the Empire against Bedouin marauders. It was on one of the main lines of migration between the east and west



CENTRAL BUILDING OF THIS GROUP AT THE CHICAGO MUNICIPAL AIRPORT IS ONE OF THE LARGEST CLEAR-SPAN HANGARS

Insuring Safety on Airlines

Behind the Pilot Is a Far-Reaching Organization, Every Member of Which Is Working for the Good of the Service

By LESTER D. SEYMOUR

General Manager, National Air Transport

OPERATING an air line has a fascination akin to any human endeavor requiring the co-ordination of a large number of separate functions to attain a particular objective. As these operations increase, the separate efforts of a large number of people become increasingly important. Perhaps no better illustration of what I have in mind may be had than from the following quotation taken from an issue of the *N. A. T. Fly Paper*:

"Airman. What a word to inspire the imagination! A dream of centuries come true, resulting in a people that may be described by such a magic word. Not all may fly, but as truly as the lowliest private and the greatest general are both described by the word soldier, so may the dirtiest 'grease monkey' and the greatest pilot be termed airmen.

"Over the Alleghenies on the blackest night, through blinding fog as the mail roars on its way, it is accompanied and guided by the hand and brain of an airman. On an ice-covered field, in the blast of a zero wind, a fleet messenger of the air is being fueled. Guarding each gallon from the elements that the engine may have but the cleanest of gas, testing each plug that no chance of failure may remain to endanger a life at stake, you find a man who perhaps never flies but is nevertheless just as truly an airman.

"Some are in cockpits; some at the gas pumps; others at a bench; some making a weather map; some pushing ships into shelter; others with no specific task more important than to help wherever they can—all airmen."

Air transport lines, being only another type of scheduled transporta-

tion, have discovered that they may look to the history of the railroads for precedent in many ways. Except for differences in equipment the problems of the railroad and the well organized air transport line are much the same. Both depend to a large extent on that intangible but extremely important thing called *esprit de corps*.

In air transport work particularly it is essential that every man, in whatever capacity, realize the importance and relation of his particular job to the entire task. This may be because of greater speeds involved, the smaller independent units, and because a failure of motive power may be more serious when a vehicle moves in two dimensions rather than in only one. The comparatively fragile nature of aircraft and the conditions under which they must operate have much to do with the situation.

PERSONNEL employed in the operation of an airline require a greater average of skill than in other modes of transportation for the same reasons. This has been one reason for air transportation offering such great opportunities to specialists.

Certain positions of trust in an air transport line, however, seem to demand many widely varying abilities in one individual. It has been said that a man who attempts to be a jack of all trades is a master of none. On the exception to this proverb rests the success of the air transport pilot. In flying on schedule through all kinds of weather, the actual manipulation of the controls of the airplane is the least of the pilot's worries. That ability is something that he has attained and long since taken for granted

somewhere back in his early flying experience. In addition, he must at the same time exercise no mean ability as a meteorologist, aerologist, and weather forecaster. He must also continuously function similarly to the navigator of a ship on the sea, and in some instances operate a radio transmitter. These duties require perfect co-ordination of brain and hand.

The pilot has no little responsibility. He must not only complete his schedule on time but complete it safely. He has in his control an airplane which cost his employers many thousands of dollars.

The value of his cargo is difficult even to guess. If it happens to be passengers, he is responsible for one to fifteen lives. If his cargo is inanimate, mail or express, it may have any intrinsic value from zero to a huge sum according to the contents of the letters and packages. In either case he can only know that his responsibility for getting the cargo to its destination is too great for him to calculate. It has been said that the responsibilities and duties of such a pilot combine those of the captain, navigator, and chief engineer of a ship, the locomotive engineer, train dispatcher, and railroad conductor.

Leaving for the moment the actual task of flying the airplane, duties equally important devolve on the ground organization. It has been truly said by one of our pioneers "that there is more to aviation than flying." For every airplane in the air someone, somewhere on the ground, must have made sure that every bolt, nut, and turn-buckle is tight and in its proper place; that every piece of metal and fabric is of proper strength and in

perfect condition, and that every engine and instrument is more than capable of its task.

Even the man whose duty is no more difficult than filling the fuel tanks has the responsibility of being sure that the tanks are really full, that the gasoline is clean and that his job is done at a time which will not interfere with the schedule or other work which the airplane may require in servicing.

Somewhere another man must be responsible for the collection and transmittal of accurate weather information, and another that it gets to the pilot when he needs it. Other men must be sure that the radio, whose beam the pilot follows through the clouds and fog, is kept operating and that the weather broadcast is accurate and ready at the exact time the pilot expects or needs it. He must further hold himself in readiness for the transmission of any emergency messages that may be necessary. A little incident will serve to show the necessity of quick action with the radio.

One of the N. A. T. pilots left Bellefonte, Pennsylvania, east-bound with the mail in fog so thick that it was impossible for him to see more than his lighted instrument board before him. He "took off," however, with the knowledge that at Hadley Airport, his destination, there was some 1500 feet of "ceiling."

PERIODICALLY along his journey eastward he was informed of weather changes as they took place. However, when he actually reached the field and flew over it, a sudden change of which he had not been informed had taken place since the last weather broadcast. As his ship went roaring across the field, which he could not see although he knew that he was over it, he found that the 1500-foot ceiling had disappeared.

He had no way of knowing whether the fog extended all the way to the ground or whether it might be clear underneath for a few hundred feet which would permit him to descend safely. With the ship roaring overhead, the field manager sensed the situation and rushed to the radio room of the Weather Bureau where he advised the pilot that there was still approximately 300 feet below the fog. The pilot turned back, came safely down through the clouds, and landed. Only a sense of responsibility, knowledge of what to do, and doing it quickly brought the mail in on time and perhaps averted a disaster.

The actual organization of an air transport line varies with different

companies. They have, however, certain more or less definite points in common. At each field along the line a crew of service mechanics responsible to a field manager is stationed. The field managers are responsible to a division superintendent stationed at some central point on the line from which flying activities are directed.

If the line is sufficiently long to warrant two or more divisions, then the division superintendents are responsible to an operations manager. If not, the division superintendent himself usually serves as operations manager responsible only to the general manager or operating head of the company. The pilots who fly the line are also responsible to the division superintendent or operations manager. Major overhaul and repair of the airplanes and engines is in most instances separated from service repairs and operated as an independent unit.

Airplanes and engines are periodically taken out of active service and put through this overhaul shop before

Experience seems to indicate that airplanes may now be continuously flown a distance as great as 2000 miles between complete inspections and that complete overhaul may be required in the neighborhood of every 1000 or 1200 hours. An engine whose life may be estimated at 300 to 1500 hours is now expected to run from 250 to 300 hours between major overhauls. Of course, minor repairs and daily service are required on both airplanes and engines as the result of the rigid daily inspection.

The weather service, which plays such a large part in modern scheduled air transport, is operated either by the government or by the lines themselves when the governmental service is not available. In either case this service consists of the collection of weather information along the line and some distance on each side of it at intervals of from two to four hours, and the dissemination of such information to proper stations along the route.

Data so collected, together with general weather maps and weather information furnished by the government, are made use of by the pilots in judging whether to fly through or over certain storms and atmospheric disturbances, and what may be their chances of getting through.

The information is disseminated by land wire telegraph and telephone and radio telegraph and telephone. Like railroad trains, the airplanes are dispatched and kept track of along the line from a central operating point.

THE pilot usually flies from three to five hours on consecutive days with one and in some cases two days off for rest between trips. Those who think that the pilot's life is an easy one because he has so much time off need only follow him for a few weeks to discover that under certain circumstances he does as much work on one trip as most people do in a good many days.

The pilot's discipline is in most instances none the less rigid because self imposed. He knows that he must keep in the best condition in order to be equal to his task. In itself it places rather definite restrictions on one's mode of life. Every pilot is ambitious to complete on schedule that portion of the route assigned to him.

The traditions of the service handed down from the days when equipment would permit of nothing like the present regularity are such that if it is humanly possible the trip is completed. No other urge is necessary. The pilot's pride is in the success which his com-



INSPECTION

Every plane on the N. A. T. lines is carefully inspected by competent mechanics before a scheduled flight

being put back onto the line to replace others which in turn are taken off for their periodic overhaul. The shop mechanics are responsible to a shop superintendent who may either be responsible in turn to the manager of operations or to the general manager independently as the case may be.

Such functions as engineering, accounting, publicity, advertising, and traffic are usually separate departments of the company responsible directly to the general manager. They serve as advisory and complimentary services to the actual flying.

pany makes of the route, and he knows that when he is in the air he has it in his power to alter this record in proportion to how well he does his job. He is always endeavoring to do it a little bit better than someone else might do it under the same circumstances.

On air transport lines various methods are employed to pay the personnel. Pilots receive in some cases a fixed monthly salary of from 300 to 500 dollars or more. On other lines they receive a base salary of from 1600 to 2400 dollars a year, plus from five to ten cents a mile, depending upon the route they fly and whether it is day or night flying.

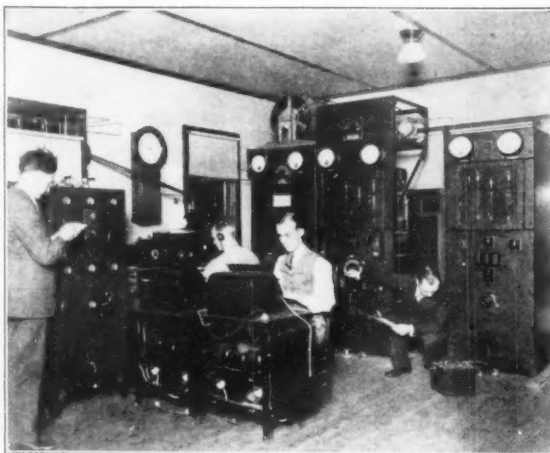
MECANICS are paid either on an hourly or weekly basis. They receive from 35 to 40 dollars a week and upward according to their skill. Helpers receive from 25 to 30 dollars and upward in proportion to their skill and progress toward a full mechanic's rating.

The schedules on air transport lines are maintained in proportion to the effort and vigor with which those charged with flying the route accomplish their purpose within the limitations placed by weather and natural obstacles. At the present state of development it is still true that a graph showing the year's operations clearly indicates the effect of the seasons. Efficiency of operations falls off somewhat in the winter and mounts in the summer.

Fortunately, airplanes are growing better. Aids to navigation are growing more numerous and the discrepancy between summer and winter operations efficiency is decreasing. A graph showing the regularity of keeping to schedule on one line was made covering a year's period and compared with a similar graph showing weather conditions over the same period. Except for differences in scale, these two curves were almost identical. Undue delay, or failure to fly the route as a result of poor equipment or poor maintenance, have been very nearly eliminated.

On the line between Chicago and New York, flying has been carried out with nearly 100 percent efficiency all during the summer months. In a three-months period the average flying time between terminals has been less than schedule. Only a fraction of 1 percent of the trips has been defaulted and these were entirely due to weather conditions. This experience is not unusual and should be expected of any well operated line equipped with proper aircraft and assuming average weather conditions.

In the past few years concentrated effort to develop aids to air navigation, particularly for use at night and under conditions of poor visibility, have resulted in much improvement. The radio beacon, or radio range as it is technically called, has been put to work. By means of especially designed radio equipment, pilots now follow it between Cleveland and New York over the lines of N. A. T. Al-



GOVERNMENT RADIO BEACON AND BROADCAST STATION

though it is invisible to the eye, it affords a definite roadway for the sky traveler like the ribbon of concrete for the automobile on the ground.

Powerful light beacons have also been developed and placed at frequent intervals along the routes, to aid the aviator at night. These light-houses of the air consist of large rotating searchlights whose rays may be seen on the horizon for distances up to 50 miles or more on a clear night. Because few nights are clear, these beacons are placed in most instances as close as ten miles apart.

THESE beacons are guarded as carefully as the lights which guide the ships along our coasts. The traditions of the light keeper who lives year after year on the rockbound coast with only an ambition never to let his light fail are no more exacting than the duty which keeps the caretaker on the job to see that the airway beacon is always lighted and functioning properly. These beacons, like light-houses, are under the jurisdiction of the United States Government. Incidentally, they are under the supervision of the same office, the United States Bureau of Lighthouses.

Likewise, the Weather Bureau of the United States has come to the assistance of this newest means of transportation, and is giving invaluable assistance from a multitude of new stations. Their duty is to collect and disseminate weather information specifically prepared to be of the most

value to everyone who travels by air.

The business organization of an air transport company is divided into two parts. First, that which has to do with the functioning of the line incident to carrying the cargoes with which the company is entrusted. Another part of the business organization sells the service and seeks to familiarize the public with the service offered. This organization, variously termed the traffic, commercial, or public relations department, functions much the same as the sales organization of any other company.

Because the activities of an airline are stretched over a considerable distance, the commercial organization is compelled to have a number of district offices. One is to be found in each of the most important cities through which the line operates. From these offices under the direction of a district manager, all matters pertaining to advertising, publicity, business solicitation, and public information are handled.

Because air transport is so new, and because the public has not yet become accustomed to thinking of air travel in the same way that it thinks of surface travel, the business organization of an air transport line must carry on a continual effort to familiarize the public with the capabilities and possibilities of using aircraft in their business and social life.

SURPRISING as it may seem, although over 40,000 miles are flown every 24 hours by the airmail in the United States, and perhaps half of that distance flown over passenger routes, many individuals still are not aware of the advantage which this new means of transportation offers to them personally in facilitation of their business. A rather humorous incident illustrative of this comes to mind.

Not long ago a gentleman leaving Chicago for New York on one of the popular extra-fare trains discovered after hurrying onto the train that he had forgotten his false teeth. He had left them in his hotel room in Chicago. He mentioned this to the dining car steward at lunch time and the steward suggested that perhaps he might care to make use of the airmail. At the next railroad station a telegram was dispatched to the hotel in Chicago asking that the missing false teeth be airmailed to a certain New York hotel. The next morning the gentleman was happy to find his false teeth awaiting him at the hotel upon his arrival in New York.

Whether or not air transport "pays" is a difficult question to answer. Many people who should know believe that

the operation of an air transport line is already a profitable business. Others hold that it is still too new for them to judge whether or not that which appears to be profit at the moment may actually and safely be so termed. This is because no two airlines now in existence operate under identical conditions. Loads carried have not become stable enough to determine what the ultimate may be.

In general most of the airlines operating under government contracts carrying mail in the United States are showing a profit. Except in perhaps a few isolated cases, the same is not true of scheduled lines carrying only passengers. This is mainly because airplanes as yet available for these operators do not carry enough passengers to make the unit cost per passenger mile sufficiently low to show a profit with the number of passengers that are attracted to the service. This in turn is the result perhaps of two factors. One is that not a sufficient number of people have as yet become familiar with the advantages of air travel and another that for a large number the prices which must be charged under present circumstances are too high to be attractive.

With this in mind, it appears that the developments which will make air travel in the United States more popular are such improvements as will bring the cost of air travel within the reach

scheduled airline operations are surprisingly free from occurrences resulting in fatal accidents and that most of the airplane accidents which occupy so much space in the pages of the public press are the result of irregular flying such as training, stunts of one kind or another, or some other hazardous type of flying that would never be experienced by a passenger on any regular air line.

Statistics from our own service in this respect may be of interest. Since the beginning of operations we have flown more than 5,000,000 miles. In all of this flying, five lives have been lost. These were pilots whose lives were lost in the service of the airmail as the direct result of weather conditions beyond human control and at a time when no passenger would have been in the air.

Likewise, ships are lost at sea in those rare instances when nature takes a hand in things and causes such weather conditions as are beyond the power of any man-made craft to endure. No doubt in whatever way we learn to travel in the future, this will still be true as it has been in the past. From the standpoint of comparisons it is felt that even with the meager progress which we have made to date, airplanes flying in scheduled service, licensed by the government, and operated by licensed personnel, afford no greater danger to the casual passenger than

landed he was asked for an explanation. Shouldering the blame for the delay, the pilot explained that he had been forced to choose between maintaining his schedule and possibly saving several lives. In a village somewhere between Bellefonte and Cleveland he had noticed a house on fire. He could see that no one had given an alarm. Apparently the occupants of the house were asleep, totally unaware of their grave danger.

With his motor roaring, he zoomed over the house, returning again and again in an effort to awaken the occupants. Within a few minutes the people were aroused by the noise. They rushed out of the burning house in their night clothes, sounding an alarm in time to keep the fire from spreading and causing more serious damage. Some time later, with appropriate ceremony, the airmail pilot was made an honorary member of the village fire department.

As time goes on and the business increases, the organization of the lines will change to meet the situation. As it stands today, the United States mail forms the largest portion of the cargo. Express operated in conjunction with the Railway Express Agency forms another portion of the cargo. Likewise, on certain lines, passengers are carried with the mail. Undoubtedly the division of cargo will change as time goes on, as will the capabilities and limitations of aircraft and communication systems. With these changes will come changes in organization and with the expansion of the lines to cover the country and serve its cities more completely, so will the organization expand and become more adapted to conditions as they appear.

When it comes to considering air transport as a career, the answer would seem too obvious for comment. Here we have not only the newest but the greatest phase of transport development in the history of the world, in its infancy. It is no more possible to predict at this time what changes in our every-day life the use of aircraft will bring about than it would have been possible 20 years ago to have predicted with any degree of accuracy what changes in our life or what opportunities were about to be made possible by the increasingly wide-spread use of the automobile.

If one stops to consider, the automobile has not only affected the lives of each one of us but it is surprising how many of us are living in a manner that could not have been true were it not for the automobile. This is true even in addition to the hundreds of thousands of people who are actually employed either in the manufacture or operation of the automotive vehicle. The same will be true, except in a much greater measure, as the result of the airplane.



LOADING EXPRESS PACKAGES IN A TRANSPORT PLANE

of a larger number of people. When this can be done either by the use of airplanes carrying 20 to 40 passengers, or when smaller airplanes can be operated at a considerably less cost than at present, it is believed that airlines carrying passengers will prosper. Fear of the air no longer prevents people from riding, if a reasonable price can be charged for the service.

Undoubtedly the matter of fatalities as the result of air operations in the past have had a great effect on the public. Actual statistics indicate that

other established means of transportation.

An incident which occurred some months ago revealed an interesting cause for a delay in transporting the airmail. Incidentally, it gives a good indication of the thoroughness with which the cause of each deviation from the schedule is investigated by those in charge of flying operations.

The westbound night mail from New York was late reaching Cleveland—later than warranted by prevailing weather conditions. When the pilot

The Art of Pliocene Man

More Discoveries Made in Eastern England Strengthen the Belief That Very Ancient Man Was Highly Intelligent

By J. REID MOIR

Fellow of the Royal Anthropological Institute of Great Britain and Ireland

WHEN, in 1909, I discovered the flint implements of Pliocene man beneath the Red Crag of Suffolk, England, it was at once apparent that these artifacts were by no means as primitive in their forms and flaking as their great age would have led us to expect. In fact, a study of these specimens soon satisfied me that their shaping had been carried out by people having a considerable knowledge of the fracture of flint, and that it was not possible to believe such implements were made by some semi-human, ape-like creature.

The complex and clever manner in which the "rostrum-carinate," or eagle's beak, specimens had been produced showed that thinking brains were operating in Suffolk some 500,000 years ago, and this conclusion was supported by an examination of the other sub-Red Crag implements such as side scrapers, push-planes, borers, and choppers.

The Pliocene implements of East Anglia are made in the great majority of cases by the removal of large flake scars, and anyone who has flaked flint and attempted to shape it to any desired form will have realized the extreme difficulty of doing so by means of such bold flaking. It is, in fact, easier to make an implement by the removal of small flakes, such as were detached in late and Stone Age times.

THUS the extensive amount of material which I recovered from the Bone Bed beneath the Red Crag convinced me that on the ancient land surface of Pliocene times in East Anglia there lived a race of hunters who were adepts in flint flaking, and who had progressed some distance upon the path of human evolution. In order to demonstrate the truth of this statement I have drawn a sketch of a beautifully-made scraper in flint from beneath the Red Crag at Bramford in East Suffolk. It is made from a flake, and will compare favorably with many of the scrapers produced at much later periods.

Having thus realized the state of advancement of Pliocene man, it was not, therefore, a great surprise to me to find associated with his flint implements certain specimens of shaped bone. The Bone Bed beneath the Red Crag is, as its name implies, rich in ossiferous remains, chiefly in a fragmentary state. These bones are of widely different ages, some dating back to the Eocene



THE AUTHOR POINTING TO THE BONE BED

Above this bed are: Loamy Red Crag sand, 48 inches; glacial gravel containing many flints, 58 inches; upper chalky boulder clay laid down by an ice sheet, 36 inches; surface soil

Epoch, while others are to be referred to the end of Pliocene times when the Crag Sea was invading the slowly sinking coast of East Anglia. It is evident that the people of those days had realized the many uses to which bone could be put if suitably shaped, and I illustrate two specimens from beneath the Red Crag. The drawing in the right-hand column of the opposite page shows views of a pointed bone made from a large piece of rib. It is most definitely artificial and would have served admirably for making holes in skins and for other similar purposes. The specimen illustrated in the center of the opposite page is even more remarkable. It is also made from a large piece of bone and at one end has been rubbed into a well marked hollow. In dressing skins such a tool would be of great value, as the pelt could be placed over a rounded stick and "dressed" by means of the hollowed bone held in the hand.

The bone implements from beneath



THE REMARKABLE FIND

The sling stone described in the text. Marks due to shaping show clearly

the Crag are of great variety. They are very highly fossilised and when struck with another hard object ring as does metal. Often, as in the case of the specimen just referred to, they have been perforated by the boring mollusca of the Crag Sea which inundated the land surface upon which Pliocene man had lived.

Although these discoveries in such an ancient deposit of well-made implements and bones were sufficiently surprising, they pale into insignificance when compared with another specimen, the discovery and details of which I will now describe.

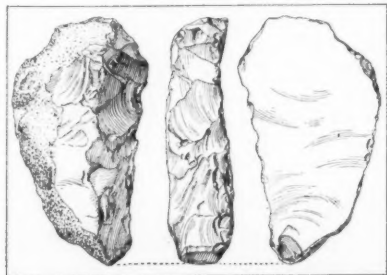
DURING the year 1926 I conducted excavations in the Bone Bed beneath the Red Crag at a pit designated as Pit No. 1 on the north bank of the River Gipping at Bramford, near Ipswich. The photograph at the top of the page shows the section of the pit, the Bone Bed lying at the base, upon the harder clay upon which I am standing. In their work at this quarry its owners remove and dump the surface soil, the boulder clay, and the glacial gravel, while the loamy sand, representing the Red Crag, is utilized in making bricks. When we started excavating in 1926 we found an area of considerable extent of this loamy sand left in place upon the underlying Bone Bed, and before beginning to search for any specimens in this latter deposit the loamy sand was barrowed away. Thus it is clear that any object found in the compact Bone Bed must be referred to that deposit and could not have been

derived from any higher and later accumulation. The Bone Bed at Pit Number 2, Bramford, rests at an elevation of about 100 feet and occupies its normal position in the area under discussion upon the surface of the harder clay. Further, its contents, as examined by me, accord with those of the other exposures of the same deposit in various parts of Suffolk, and are made up of typical Bone Bed material. Moreover, the beds surmounting the loamy sand at Pit Number 2, Bramford, do not exhibit signs of glacial disturbance such as might have ploughed into the Bone Bed and rearranged it with later material.

The conclusion therefore must be that the remarkable object now to be described which was removed from the Bone Bed by my trained excavator, John Baxter, formed an integral part of that deposit.

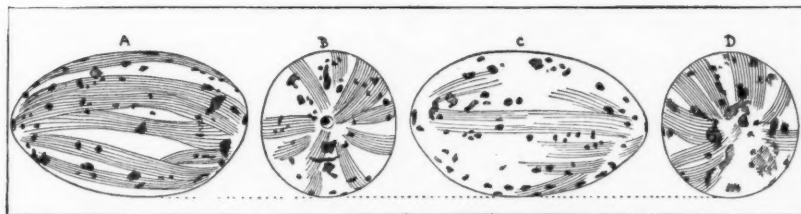
WHEN the diggings carried out in 1926 were in progress, the various specimens deemed worthy of preservation were brought to my house, labeled, and put away in drawers. Among these items was an egg-shaped object which my excavator brought home because of its somewhat unusual form. This specimen, I regret to say, I did not submit to any close examination, and its real and remarkable nature remained unrecognized until the occasion of a visit to my house of the distinguished archeologist, Professor H. Breuil. Prof. Breuil was greatly impressed with the object and, at my request, wrote the following account of it for insertion in the records:

"While I was staying in Ipswich with my friend J. Reid Moir, we were examining together a drawer of objects from the base of the Red Crag at Bramford, when Mr. Moir showed me a singular egg-shaped object which had been picked up on account of its unusual shape. Even at first sight it appeared to me to present artificial striations and facets, and I therefore examined it more closely with a mineralogist's lens. This examination showed me that my first impression was fully justified and that the object had been shaped by the hand of man. In shape it is like a rather elongated egg,



PLIOCENE FLINT SCRAPER

"There lived a race of hunters who were adepts at flint flaking. . . ." See the text



FOUR ASPECTS OF THE MANUFACTURED SLING STONE

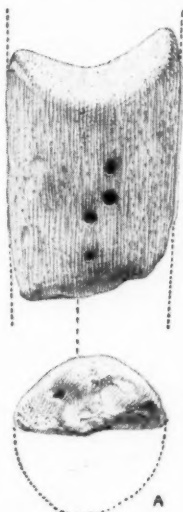
Drawn by the author. Natural size. The Pliocene Epoch preceded the Pleistocene, or glacial Epoch, but the author and some others place the first glaciation in the Pliocene Epoch

with one end slightly blunter than the other. At each end there is a small depression or punctuation, and other punctuations are visible on the body of the object, four or five being grouped together in places into a rhomboid, or a straight line. It is possible that these are merely due to the decomposition of crystalline grains included in the general mass (which appears to me to re-

somewhat smaller it recalls the steatite sling-stones of New Caledonia.)"

With this excellent report I am in agreement. The specimen has now been submitted to various well-known archeologists who have without exception agreed that it is artificially shaped, and conforms in its general appearance with the sling-stones mentioned by Prof. Breuil. The object, which is of a greyish-brown color, weighs, approximately, one half ounce. It measures in greatest length $1\frac{3}{4}$ inch, and in greatest width $\frac{7}{8}$ inch. The material of which it is composed seems now very hard and its exact nature, at present, remains in doubt. I imagine that, at one time, the specimen must have been in a somewhat softer condition to allow of the shaping being carried out as, in its present state, such shaping would, I believe, be impossible. In experiments I conducted in shaping clay with a sharp piece of flint I found that I produced markings in every way comparable with those observable upon the "sling-stone."

The specimen is illustrated by a photograph and by drawings which

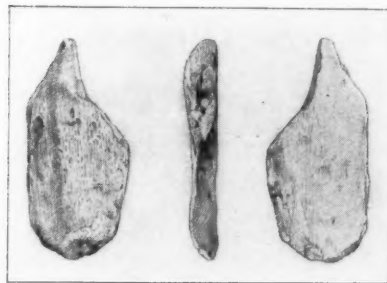


SKIN DRESSING TOOL

This also was found in the Bone Bed. It was doubtless used for dressing skins

semble steatite). These tiny depressions are still filled with grains of sand cemented with ochrous and manganese material, spots of which have stained the object at various points on its exterior.

"The whole surface of the 'egg' has been scraped with a flint, in such a way that it is covered with a series of facets running fairly regularly from end to end. Each one of these facets is made up of a number of longitudinal striations, the fine parallel lines being of unequal depth, as though they had been made by a slightly broken edge of flint. A number of fine concentric incisions are visible at one of the poles; and others more or less oblique, one of the latter being fairly deep. The scraping described above covers the whole surface of the object and penetrates into its irregularities. As it stands, the object is entirely artificial, and although



ANOTHER FIND

A piercing tool made from bone. These drawings are three eighths natural size

are reproduced above. The photograph appears on the opposite page.

There would seem to be no need to stress the importance of the discovery of this "sling-stone" in a Pliocene deposit. It has suddenly illuminated, as it were, the human Pliocene stage, and shows us a picture of man's advancement hitherto regarded as impossible at that remote epoch. This "sling-stone" is more than an ordinary artifact—it is a work of art—and its significance upon our whole outlook on the antiquity of the human race must be profound.



Courtesy Californians, Inc.

PART OF THE BOULEVARD FROM SUTRO HEIGHTS

An old section of the esplanade that is built along the sea beach of Golden Gate Park. The new and broader extension runs off in the distance. It is a popular recreation point

Esthetic Engineering

How San Francisco Anchored Shifting Sands and Built a Beautiful Boulevard on What Had Been a Barren Waste

By C. W. GEIGER and RUTH SABICHI

MANY of San Francisco's civic achievements have excited universal admiration. And no wonder! A smouldering mass of ruins after the earthquake and fire not quite a quarter of a century ago, this Pacific Coast city has had the advantage of being able to start anew, practically to build according to modern ideas from the ground up and to take advantage in its city planning of experience gained from the former mistakes which the disaster had blotted out. The spirit of modernity therefore prevails in a great many of the city's buildings and public works.

The foresight of the city planners is reflected in a thoroughfare which is now nearing completion under the direction of the San Francisco Park Commission with Superintendent John McLaren in charge. In fact, this new boulevard, which is called the Great Highway, is said to rank second to no

other of this city's proud possessions. It is 400 feet wide and extends from the world famous Cliff House in the city, three miles southward to Sloat Boulevard. Extension of the solid concrete esplanade from Fulton Street to Lincoln Way is a part of the work. This covers the entire frontage of Golden Gate Park and its completion will mark the culmination of years of planning.

THERE are three primary phases of this great work: the construction of the concrete esplanade, the use of sea bent grass for building up the area on which the highway is constructed, and the building of the highway itself.

At the section near Lincoln Way, where the work under the careful supervision of John McLaren is being done, a great problem was presented to the engineers. This was the conquering

of the drifting sand which previously was piled up or blown away by wind and waves. "Sea bent was the answer to this problem," said Mr. McLaren. "This deep-rooted grass, an immigrant from France, has done more to add to the area of San Francisco than any other agency of which I am aware. Sea bent, of which we planted the first seed many years ago, has reclaimed probably 150 acres along the beach from Lincoln Way south to the city limits. It has such a peculiar adaptability that it thrives best in sand where the wind is strong. The deep roots and tall leaves hold the sand so that drifting is prevented and the sand is made to pile up. By preventing the sand from blowing inland the beach has gradually been extended seaward." It is upon this reclaimed sand that the boulevard is being constructed.

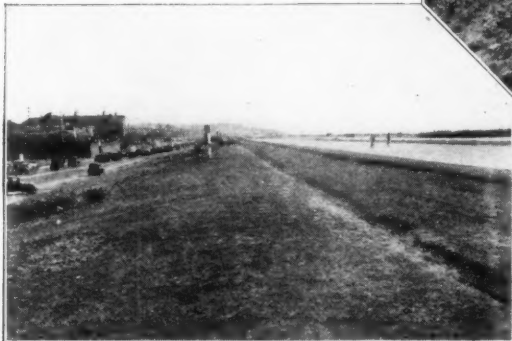
It is doubtful if there is anywhere in

the world a thoroughfare as wide and as beautifully built as the Great Highway. The various drives and walks on this thoroughfare are laid out as follows, from east to west: First, there is a 15-foot walk, then a 40-foot service road which is used for general traffic in both directions. To the west of this is a 60-foot section of lawn and shrubs sloping up to a level about 8 feet higher than the lower road. Then comes a 20-foot bridle path, and west of this a lawn



PREPARING THE BOULEVARD GRADE

The boulevard was built upon sand drifts—land that had been reclaimed by planting sea bent grass. This illustration shows the work of grading



A STRETCH OF LAWN

At the left is the eastern footpath and roadway, in front is a lawn section, and at the right are the main roadways

10 feet wide. West of this lawn there is a 50-foot concrete road for one-way traffic. Then there is another stretch of grass and shrubs and another 50-foot concrete roadway for one-way traffic. Between the western side of the last mentioned roadway and the ocean beach is another lawn set with trees and shrubs, and also a wide foot-path. From this foot-path, the slope down to the beach sands is heavily planted with sea bent and trees, generally cypress, to prevent drifting.

An underpass which will

THE "H" BEAMS ➤

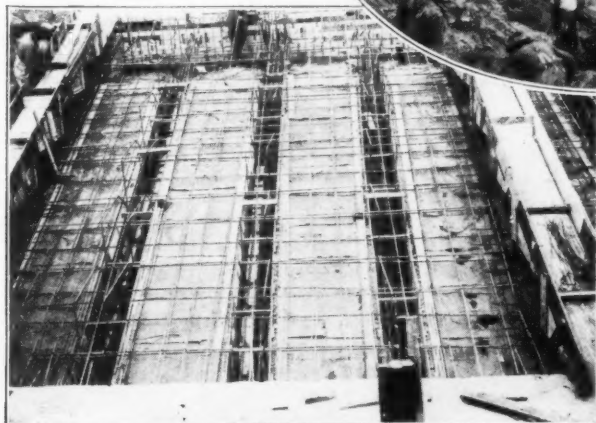
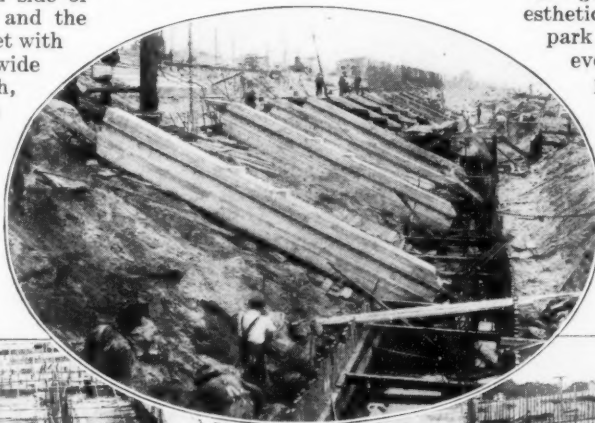
Beams to provide slip joints, in place. In the trench at their lower ends are the piles

permit pedestrians to walk from the Ocean Beach Chalet to the beach without encountering traffic, and an adjacent equestrian ramp are among the engineering features of the project that have attracted widespread interest. It is believed that the equestrian ramp is a new departure in highway construction. It will enable horsemen to ride down the face of the esplanade to the ocean and will serve further as a protection against high tides during storm periods. The ramp is built directly on the face of the

esplanade and is reached from the main highway.

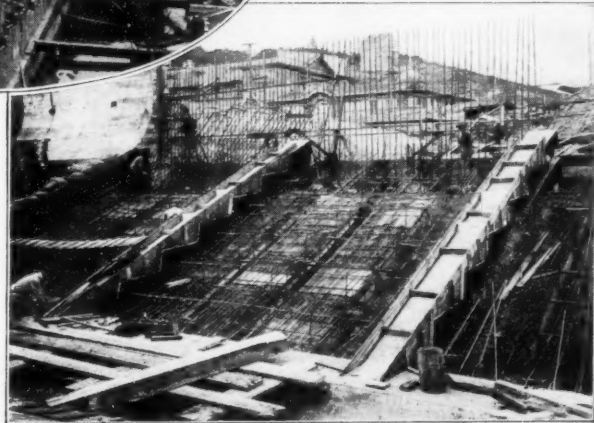
The first sections of the esplanade were built many years ago, and, successfully withstanding many winters of pounding by the Pacific Ocean, have demonstrated that this is a satisfactory method of protecting the world-famous beach. The esplanade is constantly being extended as money is provided; the last extension, just completed, provides a solid concrete esplanade from a short distance south of the Cliff House to Lincoln Way.

THE popularity of this great engineering project which lends an esthetic note to an already beautiful park is attested by the fact that every day hundreds of motorists park their cars back of the esplanade (and on Sundays and holidays this number of motorists is increased to thousands) where they may view the mighty Pacific in absolute safety. Here they may rest and watch the waves pile up the sand against the steps of the es-



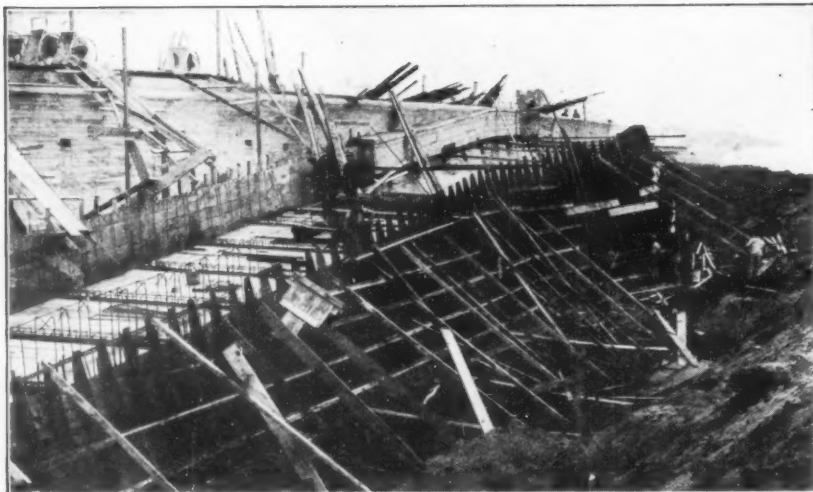
READY TO POUR CONCRETE

Forms, reinforcing steel, and the "H" beams with tar in their side grooves—all ready for the concrete. Note the complex reinforcing



THE FINISHING TOUCHES

Concrete has been poured around the projecting tops of the piles and men are making the final connections of reinforcing steel



FOR THE EQUESTRIAN RAMP

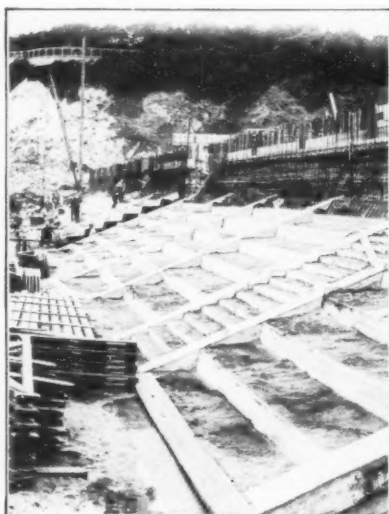
Workmen placing the forms in which is to be poured the concrete for the equestrian ramp. This ramp permits horses to be ridden down from the boulevard above to the beach sands

planade in the winter time so that the water line is far out from the base, or see it removed during the summer months so that the waves break almost directly upon the steps below them.

The esplanade has a front wall which was formed by driving interlocking concrete piling to a depth of 13 feet below extreme low tide. "Bleachers," or steps, have been built in the lower section. The top bleacher riser develops into a rollway and this rollway ends at the top of, and forms part of, a three and one half foot parapet wall with returns at each side of each stairway section. Beyond this parapet is a 20-foot concrete sidewalk with weep holes to release wave water. Behind this esplanade is the Great Highway extending from the Cliff House to Sloat Boulevard along the Pacific Coast for about three miles.

THE method of constructing this mighty esplanade which has successfully withstood the pounding of the ocean embodies several unique features. The concrete piling was placed by four water jets, one jet being held at each corner of each pile as it was

driven. The piles that form the front row—that nearest the ocean—were interlocked by means of steel construction. After the piles were driven, the sand between their upper ends was



PARTLY COMPLETED

The bleachers completed, the wall yet to be built—looking toward Sutro Heights

washed out and the space around the projecting piles filled with concrete, making practically a solid concrete wall. The steel interlocking makes it impossible for the piles to pull away from each other, either vertically or horizontally.

This steel interlocking works something like the tongue and grooving in flooring. In setting the piles, they were picked up by a crane and raised so that the interlocking steel in the bottom of each suspended pile fitted into the interlocking steel at the top of the last pile driven. It was then lowered so that the bottom of the pile rested on the sand. The jets were then started and, as the sand was washed from under the bottom of the pile, its weight caused it to sink into its final position.

THE work is provided with expansion joints in the form of heavy concrete "H" beams so that there is no danger of cracking. On each side of the "H" beams there is a groove running the entire length of the beam. Hot tar is poured into these grooves and the concrete which forms the bleachers is then poured. Running into the grooves, the fresh concrete, because of the tar, does not stick to the "H" beams, thus giving a slip joint which allows the concrete to expand and contract, after setting, without cracking any of the other work. The grooves also extend to the top of the back wall, thus binding the entire structure rigidly together, yet at the same time permitting the sections to give when struck by a high wave, due to their lack of rigidity or, we might say, due to their flexibility.

The lower ends of the "H" beams rest on the interlocked sheet piling. A concrete slab four feet thick and six feet wide binds the lower end of the "H" beams to the top of the interlocking piles. At the upper end of beams bearing on pedestal piles is a similar cap which ties the upper portion of the beams to the pedestal piles. There is also a groove, similar to those in the "H" beams, which provides expansion joints for the rollway.



IN SUMMER TIME

During the summer the bleachers, or risers, are washed free of sand by the action of the waves and furnish convenient seats

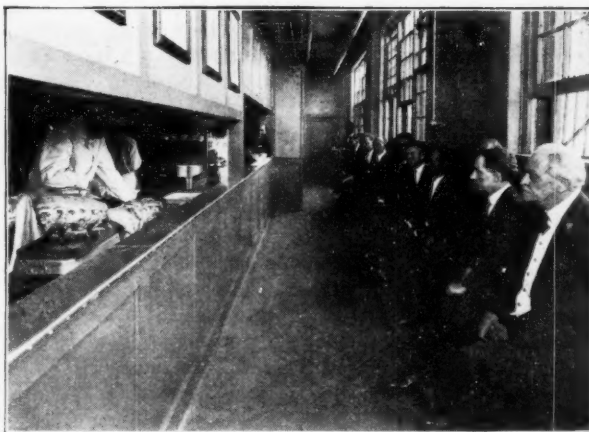


AND IN WINTER

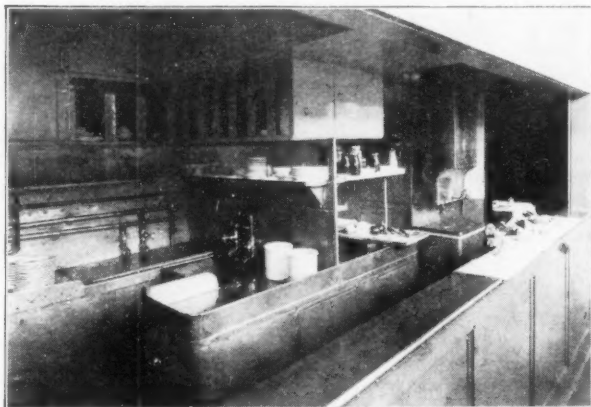
Winter storms pile up sand against the bleachers as shown in this photograph but this is gradually washed away by the waves

**CANTALOUPE BALL SALAD**

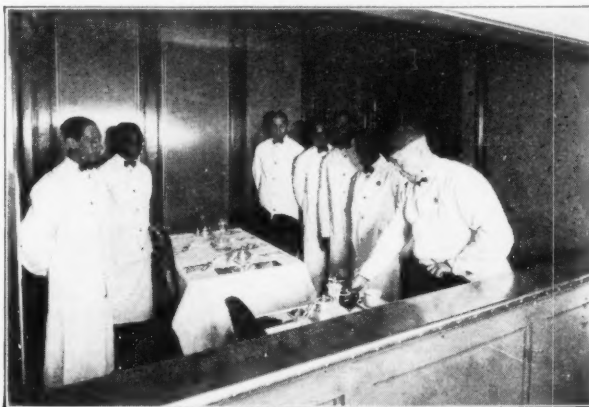
When these men get back on their cars one more dessert will be added to their repertoire. The kitchen simulates the real thing

**STEWARDS AND CHEFS FRONT**

The instructing chef is demonstrating to a group of stewards and chefs the proper method of preparing the meat for roasting

**AN IMMOVABLE DINING-CAR KITCHEN**

One end of the pantry and kitchen of the training school. The arrangements are exact duplicates of those on railroad trains

**A LESSON IN MANNERS**

This is a view of the dummy dining compartment in the Pennsylvania's training school and kitchen for dining-car employees

When the Dining-Car Staff Goes to School

YOU have perhaps often wondered at the deft service and tasteful viands which the dining car affords. These are the net result of very efficient training and the use of excellent materials. Then the question arises, "Do dining cars pay?" No, they do not. One large trunk line tells us that their dining cars "went into the red" for seven hundred and fifty thousand dollars in 1927. Another road advertises the fact that they lose 19 cents on every meal served on their dining cars. You might ask, "Why do they run them?" The answer is—competition. Passengers have to be fed one way or another, and the dining is quicker and more satisfactory than the old station restaurants where the whole trainload was disgorged for 20 minutes of indigestion.

The Pennsylvania Railroad maintains a school for dining-car employees at its commissary at Columbus, Ohio. Every dish on the menu is prepared from printed instructions, but the end is not there. Personal instruction is added in

**"ROAST BEEF RARE"**

This teacher-chef knows how to cook roast beef and his pupils will be shown how to duplicate the culinary feat

a school which is an exact reproduction, both in space and equipment, of the latest type Pennsylvania Railroad dining-car, built into and forming a part of the Columbus commissary. Every feature from kitchen utensils, range, boiler, and pantry, to the dining-room and tables for patrons, has been faithfully reproduced in the commissary. Even the connecting aisles and corridors have been retained. The men see everything done in an ideal way, by skilled instructors. Not only the chefs but the waiters receive from time to time lessons which bring them up-to-date after their initial instruction. All new employees undergo rigid training and instruction before actual service on the road. Under the present arrangement the men go to school for an hour's instruction before they leave for their road trips. The average employee spends approximately three hours a week at school. Tests are also made to develop improved methods in the preparation of dishes and their combinations to be served on the diners en route.

THE WHOLE FAMILY FLIES

The Ford trimotor plane is in use on several airlines, and inspires passengers with its readily apparent staunchness



American Passenger Air Transport—III

Many Facts of Great Interest to the Prospective Airline Passenger Are Here Discussed at Length

By PROFESSOR ALEXANDER KLEMIN

Daniel Guggenheim School of Aeronautics, New York University
Associate Editor, SCIENTIFIC AMERICAN

(Concluded from November)

IN technical circles, there is still some argument as to the comparative merits of single-engined and multi-engined planes. The arguments in favor of the single-engined plane are somewhat as follows: That they give the pilot less to think of at one and the same time; that the pilot has fewer gauges to look at and only one engine to listen to; that a single-engined plane is more efficient than a multi-engined plane; that, while undoubtedly a multi-engined plane is more reliable as regards power plant, there are other hazards such as stalling, pilot's mistakes, fog, and bad weather to contend with, and that a multiplicity of engines is no safeguard against such hazards.

The very definite replies to these arguments is that safety is paramount and that while a more reliable power plant does not of itself insure safety, it is a most important contributing factor; that the pilot of a multi-engined plane soon accommodates himself to his task; and that nothing contributes more to a feeling of security among passengers when flying over unfavorable terrain, than the sight of three powerful engines in lieu of one.

No less an authority than Colonel

Lindbergh has definitely expressed himself in favor of three or even four engines. The general practice of our operators also indicates that the multi-engined idea will prevail. A survey of the various airlines gives the following data relative to the type of planes in use: Single-engined planes on 16 passenger lines; twin-engined amphibians on four lines (the Sikorsky amphibians are quite capable of flying on one engine out of the two); three-engined planes on 16 lines. There is little doubt that, as air traffic increases in volume, very few passenger lines will be equipped with anything but multi-engined machines.

IT is interesting to note General Atterbury's reasons for the selection of Ford trimotor planes for the T. A. T. "A number of tests were made by Colonel Lindbergh and his associates on the technical committee, of different passenger planes, at Los Angeles, Seattle, New York, and Detroit. These tests lasted well into the fall of 1928, as new models of passenger planes were being perfected. The type of ship finally selected for the initial order was a Ford trimotor, all-metal monoplane, capable of carrying ten passengers. The first consideration in making this selection

was that of safety. Trimotored ships can fly on any two of their three motors; and, with only a single motor running, will lose altitude so slowly that they still have a wide landing radius—more than 50 miles, for example, from a 10,000-foot altitude." Granted that more than one engine should be used for passenger air transport, there is still the question as to whether two or three engines should be used. The answer is one of simple arithmetic: If the twin-engined plane can fly on one of its two engines, then it is much safer than the three-engined craft, because it has only two engines to give possibility of trouble instead of three.

When one engine in a twin-engined plane quits, the following difficulties arise:

The engine still functioning gives through its propeller a powerful eccentric thrust, which tends to turn the machine violently round. The pilot has to apply powerful rudder, and bank the machine somewhat. Both these actions increase the horsepower required to keep the plane flying. At the same time the propeller of the remaining engine is working under disadvantageous conditions, because it has to absorb the full power of the engine while the forward speed of the plane is slow.

A few years ago, plane designers thought it impossible to meet these conditions. Now by improvement in aerodynamic design, by careful study of propeller characteristics, and by the use of special rudders at least two twin-engined transports have definitely shown that they can fly on one engine alone. These are the Sikorsky amphibian and the Curtiss *Condor*.

IF they give proof of this quality under continued service conditions, designers may rapidly swing to twin-engine design. Besides the possibility of greater power plant reliability, a twin-engined machine has a number of advantages. The propeller placed at the nose of a very large cabin fuselage is never highly efficient. In the twin-engined job, no such blanketing need be feared, since the engine nacelles can be nicely streamlined. The pilots can now be placed at the very front end of the fuselage where their vision is unimpeded. Engines, gasoline system, and piping can be removed from the fuselage, thus adding to the safety and comfort of the passengers. Since there is no engine in the nose, vibration is likely to be decreased in the cabin. These are all important considerations.

In view of the large number of plane types employed in passenger transport (descriptions of several of which have already appeared in the *SCIENTIFIC AMERICAN*) we shall be obliged to deal with them rather briefly. It may be of interest, however, to give greater detail on the very latest (at the time of writing) large passenger transport, the 18-

passenger Curtiss *Condor*, which presumably embodies much of the experience gained by operators to date. (See also article on page 488 of this issue. Editor.)

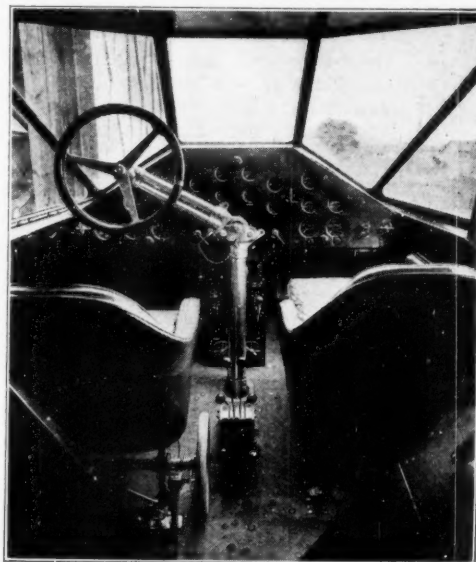
The first point of difference between the *Condor* and other large passenger airplanes, is that the Curtiss is powered with two instead of three engines. The *Condor* has climbed to and maintained an altitude of more than 5000 feet when fully loaded. If similar performance is maintained under service conditions, a real element of safety will have been added. Engine maintenance costs, an important point in airplane operation, are also likely to be less than with three engines.

Furthermore, the engines are water-cooled instead of being air-cooled. The arguments advanced are that water-cooled engines are less noisy than air-cooled types with their exposed valve gear, that with varying weather conditions, temperature regulation in the water-cooled type is finer, and that with proper care, the water-cooled type is actually more reliable. These are plausible arguments, although the "come-back" of the water-cooled type is by no means a certainty.

The general characteristics of the *Condor* are: Engines—two Curtiss Conquerors (geared down) with a total horsepower of 1200 at 2400 revolutions per minute;

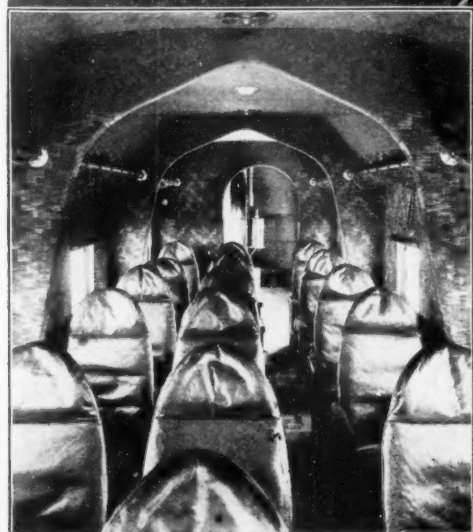
horsepower—14.47. The performance is as follows: high speed—139 miles per hour; landing speed—49 miles per hour; cruising speed—116 miles per hour; absolute ceiling—19,200 feet; and maximum range at cruising speed of 116 miles per hour—five hours.

The framework is entirely of metal, mostly duralumin. The biplane form of wing cellule was selected to keep the span to reasonable dimensions and provide a light structure. The engines are geared down 2 to 1, so that the 13-foot propellers may work in correct relationship to the speed of the plane. Wheel brakes are standard equipment, as are gasoline dump valves, running lights, and signal flares.



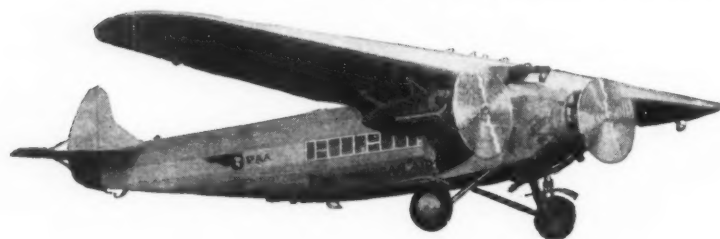
THE TWO-MOTORED "CONDOR"

Above: A three quarter rear view of this 18-passenger plane. Above at right: The interior of the pilots' compartment showing the dual controls and the complete instrument board. Left: Looking toward the rear of the passenger compartment



weight empty—11,352 pounds; useful load—6026 pounds; crew—510 pounds; fuel and oil—1916 pounds; pay load—3060 pounds for passengers, 540 pounds for baggage; gross weight—17,378 pounds; length overall—57 feet 1 inch; span overall—91 feet 8 inches; wing area—1512 square feet; wing loading in pounds per square foot—11.50; power loading in pounds per

Radio communication with the ground is essential at all times. The radio equipment, installed by the Radio Corporation of America, consists of a 100-watt combination telephone and telegraph transmitter operating on 600- to 950-meter wavelengths. Its source of power is a dynamotor which draws its current from the standard landing-light batteries of the plane. The receiving equipment is designed for frequencies used by the marine stations of the United States Coast Guard and



THE FOKKER TRANSPORT PLANE "CHRISTOPHER COLUMBUS"

the stations of the Airways Division of the United States Department of Commerce. The entire equipment weighs but 145 pounds and was developed by the Radiomarine Corporation of America. A trailing wire antenna is used.

The chairs in the *Condor* are comfortable and luxurious, although they can be lifted by a small child. They have high backs tapering to padded headrests, and are covered with durable top-grain leather. These "super-chairs" are adjustable automatically to any angle of inclination. The passenger accomplishes this adjustment by leaning back to a satisfactory position; the chairs will retain the exact angle.

Draughts or excessive cold will not be tolerated by the traveling public, yet fresh air is demanded. The *Condor* cabin has 48 cubic feet of air per person, since there are 18 passengers, a floor area of 138 square feet, and a cabin height of 6 feet 3 inches. Also there are ventilators for admitting air through the roof of the plane, and capable of being carefully regulated. One is located in the pilot's compartment, one in the main cabin, and one in the lavatory.

TO avoid the discomforts of leakage in an exhaust gas heater, steam heat is employed. Two small radiators weighing less than a pound and containing superheated steam are located below openings in the floor. The steam is obtained from two tiny boilers located in the exhaust manifolds of the engines.

The interior of the cabin is divided into three compartments, separated from each other by arches. Each compartment accommodates six passengers, and if desired the operator can shut off each compartment from the other by means of doors, thus giving the equivalent of a railway drawing room. The compartments have attractive carpets and the interiors are finished in light-weight paneling upon which the grain of natural wood has been reproduced. Over each seat is a rack on which light articles may be placed.



THE SIKORSKY S-38 AMPHIBIAN

There is a window beside each set of seats. The windows are fewer in number and smaller than one would expect, but the vision is adequate. The reason for smaller window space is probably that glass is a poor insulator of sound and heat. For sound-proofing and vibration-damping purposes an air space of approximately three inches exists between the inner and outer walls of the cabin, packed with a sound and shock-absorbing material. (See second part of this article in our November issue. Editor.)

Provision is included for the installation in the main cabin of a private compartment with four sleeping berths each 28 inches wide. For night flying the *Condor* cabin can be converted into a sleeper with 12 full size berths. Space can also be arranged for the installation of a desk set, buffet, and a refrigerating system at the order of the operating company.

All baggage is carried in two metal-lined compartments, one in each outboard engine nacelle aft of the gas tanks. This is a new wrinkle in airplane design, as it leaves all available cabin space at the disposal of the passengers, and also makes it impossible for baggage to be spilled into the passenger compartments.

This type of plane is equipped with a lavatory including wash basin,

toilet, towel racks, and mirrors.

Pilots enter their forward compartment through a door in the floor and without passing through the passenger cabin. The ladder for this entrance folds back under the ship when not in use. The courier is seated in the ante-room behind the passenger cabin.

Altogether this new plane meets admirably the requirements of passenger comfort which we have discussed previously.

One of the best known passenger planes is the Ford tri-

motor which is used by the Maddux Air Lines, the National Air Transport, the Stout Air Service, and several other organizations. This plane has the distinction of being the only multiple-engined passenger plane in America constructed entirely of metal. With three Wasp engines it has a high speed of 130 miles per hour, weighs 6700 pounds empty, and has a useful load of 4100 pounds with seating capacity for 12 occupants.

The Fokker *F-10* super-trimotor, equipped with three Pratt and Whitney Wasp engines of 425 horsepower, used by Pan-American, Western Air Express, and other airlines, took the world by storm when it made its first appearance. It is probably the fastest plane of its size in the world, having a maximum speed of approximately 150 miles per hour, and a cruising speed of 125. Its cabin is the last word in luxury, having specially constructed lounge chairs fitted to the full-vision windows, running water in a complete lavatory, toilet facilities, special compartments for personal baggage, buffet facilities, et cetera. It accommodates 12 passengers with an operating crew of three.

The amphibian gear is hydraulically operated and can be retracted in a few minutes. Carrying eight passengers and two pilots, the plane has a top speed of 128 miles per hour with two of

its engines functioning. The weight empty is 5875 pounds; gross weight is 9175 pounds. The area of the wings (the wing cellule is termed a sesquiplane because the lower wing is so much smaller than the upper) is 720 square feet.

The Sikorsky twin-engined amphibian is another famous passenger plane. It is used by Pan-American Airways between Miami and Nassau, and by Western Air Express between Los Angeles and Catalina Island, as well as by other operators, and is giving splendid service. The Sikorsky S-38 has a short boat hull which makes for lightness, and the tail surfaces are carried on a form of outrigger from the upper wing. The amphibian has again and again demonstrated its ability to fly on one engine. The design of the two vertical tail surfaces is partly responsible for this. They are placed in the slipstream of the engines and are cambered only on the side where they face one another. As a result, when one engine fails, the slip stream of the other engine automatically produces a side force on the tail surfaces in its rear, which counteracts the eccentric thrust of the propeller.

Our transport companies are extremely proud of their pilots. They are hardy, courageous young men, who have been "through the mill," either as Army fliers or airmail pilots or both. It is now fashionable to put them into natty uniforms like those of the T. A. T. pilots in our photograph. There are very specific reasons why pilots are being put into uniforms. People on the ground are apt to resent advice from a pilot whom they cannot distinguish from any other individual. From a man in uniform they will gladly receive warning of a dangerous propeller. The uniform should also help

to maintain the dignity and *esprit de corps* of the pilot. Another useful touch is calling the chief pilot Commodore and the pilot of each plane Captain.

Mr. C. M. Keys predicts, "There will grow up in this country a large class of pilots that is now represented by a handful of men on the great airmail lines of the country. These men will be as familiar with the country over which they fly as your locomotive engineers operating on short lines of the main-line railways of the country. They will know every high tree, every wire, every grain elevator, and every church spire along their right-of-way. They will be trained to a rigid discipline that will not allow variation."

PEOPLE frequently say that the pilot will ultimately sink, as equipment improves and experience increases, to the level of an aerial chauffeur. We doubt this very much. In fact the most serious problem for air transport will be the provision of a sufficient number of well trained men. There are real disappointments in store for the young men who take a short ten-hour course of flying instruction, and expect that they are in line for positions on transport lines, with possible earnings of six to seven thousand dollars a year, when the pilots of T. A. T. have each an average of flying time of over 3000 hours.

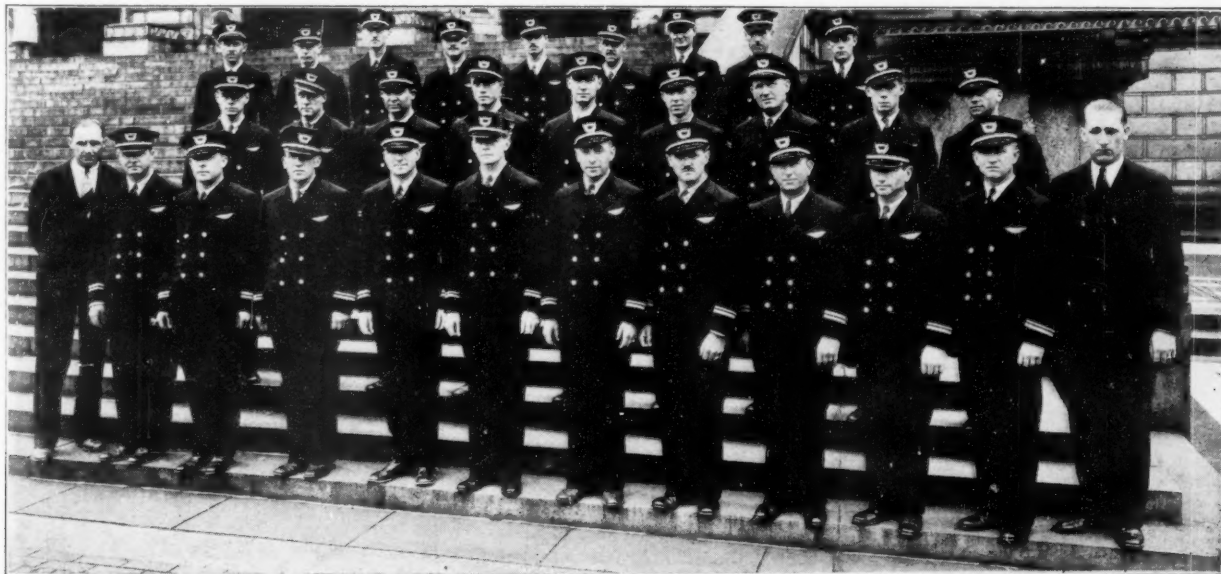
It may be of interest to our readers to know the requirements of the Department of Commerce for a school which trains Transport Pilots: such a school must give a minimum of 200 hours total flying time, of which at least 35 hours is dual instruction, and including time on two types of planes other than those used for dual instruction. Students must also be given

solid instruction in air commerce regulations, engines, and airplanes, including history of aviation, theory of flight, nomenclature, aerodynamics, rigging, meteorology, aircraft instruments, shop practice, and so forth.

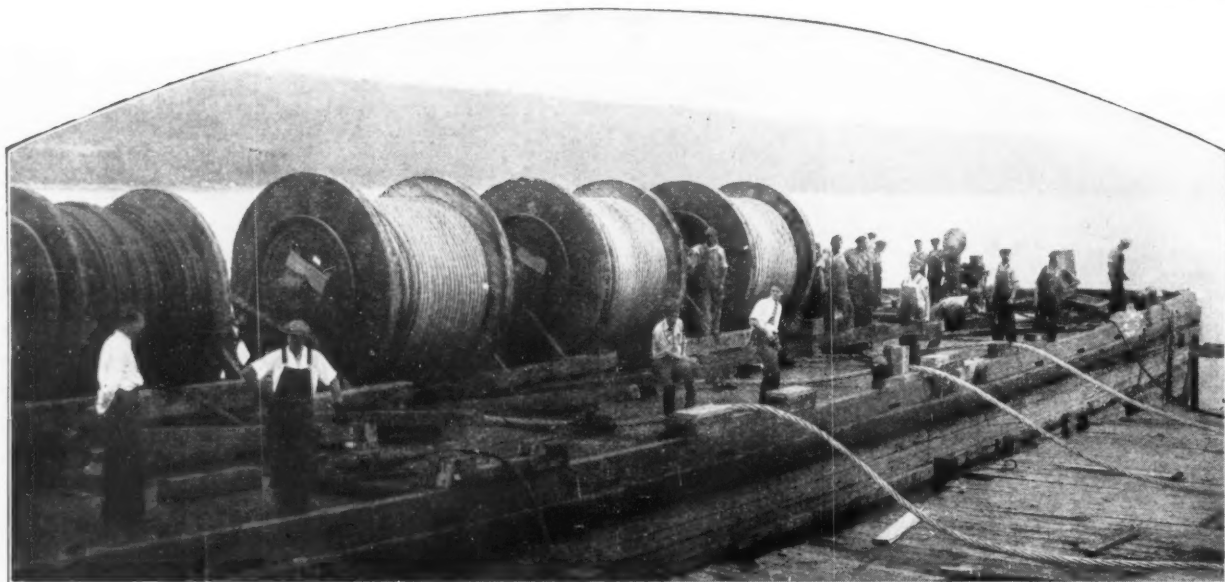
Probably a minimum of 500 hours will be needed before a pilot can graduate from the position of assistant pilot to chief pilot on a passenger machine. It is probable also that all transport pilots will receive instruction in blind flying, where a man is required to fly a plane over a ten-mile course with his view of the ground cut off, using only his instruments to guide him, while a second pilot checks the route.

One of the main difficulties that American air transport has had to face was the lack of an airport close to the center of New York City. This lack is rapidly being remedied, and innumerable airports have been, or are being constructed in cities both large and small. The first stage in the evolution of the American airport was a more or less level field, with a hangar and a large sign board. The second stage was a large, splendidly equipped landing field, well located geographically, with the long and well prepared runways, completely equipped hangars and shops, good field illumination, and service systems including fire protection, heating and ventilation, lighting of buildings, water supply, fuel and oil supply, signal and communication systems, weather service, et cetera, which is deserving of an A rating from the Department of Commerce. The next stage will have to be, if passenger travel is ever to become popular, the provision of real air passenger terminals. Colonel Lindbergh, testifying before the Joint Committee on the Washington Airport, was of the opinion that in this regard

(Please turn to page 548)



A GROUP OF PILOTS ON THE T. A. T. LINES



PREPARING TO STRING THE CATWALK CABLES ON THE HUDSON RIVER BRIDGE

Reels of wire ropes were mounted on barges and, after their ends were anchored, were paid out and allowed to rest on the bottom of the

river as the barges were towed across. They were then lifted to the tops of the towers. Catwalks were completed late in September

Wires and Cables for a Great Bridge

Manufacture of the Wires for the Cables and Suspender Ropes of the Hudson River Bridge, New York City

By A. E. CRIPPS*

PROGRESS has been called the highway of human endeavor bridging the gap 'twixt past and future. Retracing our steps on this highway, we find that nearly a century ago, in 1831, John A. Roebling, a young civil engineer, left Saxony in Germany, arrived in America, and settled in Pennsylvania. A man of vision, a disciple of progress, it was he who first introduced the art of wire-ropes making to this country. From the designing of ropes for canal portages and inclined planes, he graduated to the erection of small suspension bridges.

In 1856 the Niagara Bridge, made possible by Roebling's vision, was opened to the public. This was followed by others of increasing length until, in 1867, the Cincinnati-Covington Bridge, with a span of 1057 feet, was completed, after the pioneer had surmounted opposition and difficulties that would have dismayed any other than an enthusiast.

As early as 1865, plans had been drawn for the erection of a suspension bridge between the cities of New York and Brooklyn. Engineers scoffed and technicians derided the idea. It seemed beyond engineering reason to suppose that wire could support a span of

1600 feet at a height of 135 feet above high water, but again the visionary, with faith in his own ability, triumphed. His plans were approved by a selected board of federal engineers appointed by the President of the United States in 1869. The designer, unfortunately, was not spared to see the completion of the work, for he died as the result of an accident during this same year, on duty at his post while placing the site for the base of the bridge tower on the Brooklyn side. Work began on the foundations for this tower on January 3, 1870, and the enduring monument of granite and wire was completed by John A. Roebling's son, Colonel Washington A. Roebling, despite numerous difficulties and prejudices.

IN 1883, with fitting ceremonies attended by both federal and state officials headed by President Arthur, there was opened to the public what was then the eighth wonder of the world: the Brooklyn Bridge.

Years have passed, and during those years American ingenuity has gone from triumph to triumph in the art of bridge building. The East River has been spanned thrice since by the Williamsburg, the Manhattan, and the Queensboro Bridges. The two

former are suspended by cables made from Roebling wire. The Hudson River has been spanned at Poughkeepsie and at Bear Mountain. From the linking of cities we have progressed to joining the highway systems of sovereign states.

On July 9, 1929, the first foot-bridge cable was raised from the bed of the Hudson River and lifted to the top of two towers, one at Fort Lee, New Jersey, and one at Fort Washington, New York. The engineering marvel of the century had become more than a dream. Two great states had another mutual bond—the Hudson had been bridged.

To obtain an idea as to the immensity of this project one must necessarily draw comparisons. The Brooklyn Bridge took 13 years to build and cost 25 million dollars. The new Hudson River Bridge will be completed in a space of five years and will entail the expenditure of 60 million dollars. The former has a span of 1600 feet supported by four main cables, each with a diameter of 15½ inches and each composed of 5296 wires weighing 900 tons. The latter has a span of 3500 feet with four main 36-inch diameter cables, each weighing 7125 tons. Each of these cables is composed of 61 strands, each con-

*Of John A. Roebling's Sons Company

taining 434 wires, making a total of 26,474. The towers of the Brooklyn Bridge are 295 feet high, while those of the Hudson River Bridge are approximately 635 feet, or nearly a hundred feet higher than the Washington Monument.

Of course, with the march of progress, certain methods of construction used at the time the Brooklyn Bridge was erected have now become obsolete. These old methods have been improved upon to meet existing conditions, since the magnitude of the new project was inconceivable until recently. Without considering the ropes used in preliminary construction work, the main cables will total 57,000,000 pounds of galvanized wire, each wire having a diameter of .195 inches—nearly the thickness of a lead pencil—or 106,000 miles of wire, enough to go around the earth at the equator more than four times. The John A. Roebling's Sons Company, still operated by the sons and grandsons of the pioneer bridge builders, are manufacturing and installing these four 36-inch main cables, and are also furnishing and erecting the anchorage materials.

MOST of the wire to be used has already been manufactured, and is now in storage at the plant at Roebling, New Jersey. The stored wire covers an area of 30,000 square feet, and is stacked 8 feet high—enough to cover a New York City block to a height of two feet.

The production of steel wire for the four cables of this mighty bridge is no small task when one considers that the seven large suspension bridges in this country do not contain sufficient wire to fabricate the cables for the Hudson River Bridge, and yet this quantity of material will be produced within the specified time and not interfere with the normal production of the plant.

Steel for this wire is made by

Roebbling in 40-ton acid open-hearth furnaces. When this refined steel reaches the proper chemical composition, it is poured into ingots 14 inches square and five feet long and allowed to cool slowly. After re-heating, these ingots are rolled into two-inch by two-inch blooms which are cut into 30-foot billets. These are reheated and rolled into round rods in a new, continuous-rod mill costing 2,000,000 dollars.

After rolling, the rod is put through a normalizing process, cleaned in acid to remove the scale, and thoroughly washed, following which it is neutralized in lime and finally baked in ovens to prepare the steel rod for the cold wire-drawing operation.

IN the wire-drawing operation cold wire is drawn through alloy steel dies of successively decreasing diameters until the correct diameter of .192 inch is obtained. After drawing, the wire is given another thorough cleaning operation to prepare it for the galvanizing bath where it receives a coat of pure zinc averaging about .002 inch in thickness which thoroughly protects it from the elements. It is then wound into coils five feet in diameter, there being about 4000 linear feet of wire in each coil. Although this wire has received thorough inspection prior to its finished state and has been tested as to its chemical composition and physical properties, it must now meet severe and thorough testing in its finished state before final acceptance; that is, ultimate strength, elastic limit, ultimate elongation, and bend test requirements must be met before the wire is accepted and placed in storage. Every coil must meet these requirements. This means that half a million tests must be made to secure this quantity of material.

When the material is required at the bridge site the individual coil is rewound on steel reels, each of six-

foot barrel diameter, three feet wide, and containing 160,000 feet of wire. The individual coils are connected together by means of a special threaded connection that develops practically the full strength of the wire and makes possible a continuous wire of any length.

Special machinery has been designed by the Roebling Company to speed the reeling of the wire and to eliminate excessive manual lifting and hauling of these heavy reels. This is all accomplished electrically with a minimum of effort on the part of the machine operator. A description of the various inventions that have been developed by this company for the production and spinning of the cables for the new Hudson River Bridge would require a book to put forth, this article being too limited in its scope to attempt it.

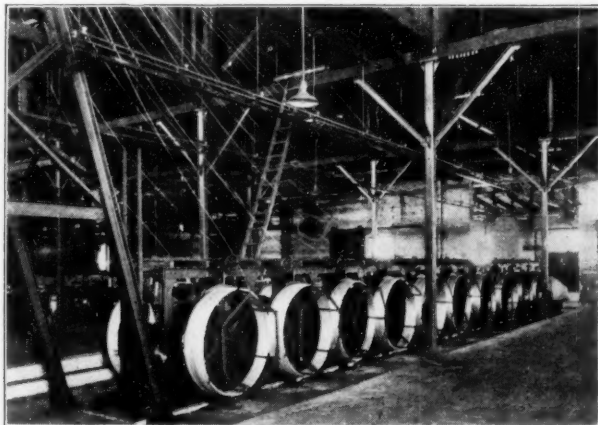
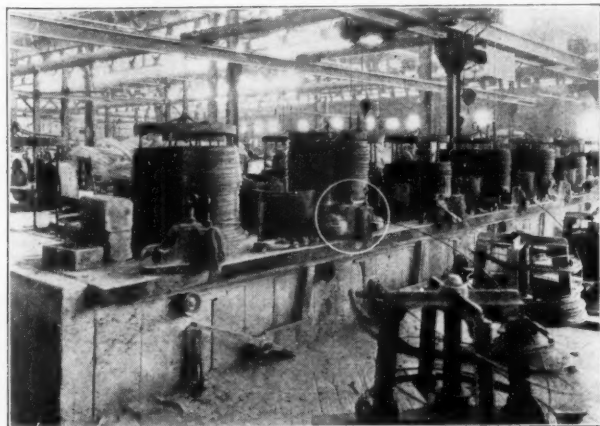
There will be about 4000 reels of wire necessary and special gondola cars have been built to carry them to tidewater. Here the cars containing the reels are transferred to car floats, and taken by means of tugs to the bridge site. From the river level they are hoisted by aerial tramways which have been constructed, one on each side of the river, to storage sheds at the anchorages.

THE anchorage on the New York side is a solid mass containing 110,000 cubic yards of concrete (enough to pave a roadway 18 feet wide and $53\frac{1}{2}$ miles long, or half the length of Long Island) in which are imbedded 1400 eye bars, approximately 40 feet long, each one over one ton in weight. There are 2100 eye bars on the New Jersey side. In all, the eye bars weigh approximately 4000 tons. The towers comprise 40,000 tons of structural steel, riveted together, on which will be suspended the four giant main cables.

There was necessarily an enormous amount of preliminary construction work to be done before the main cables

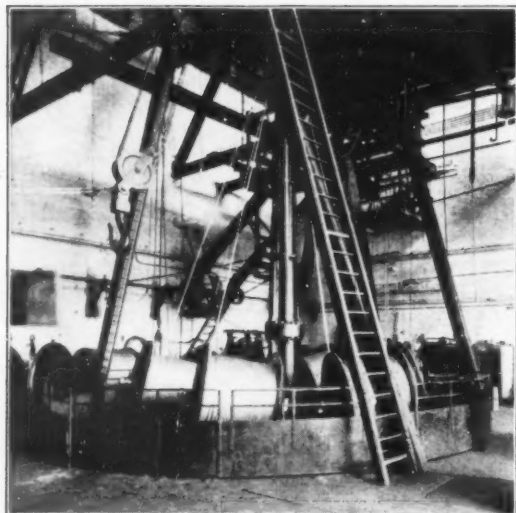
A WIRE-DRAWING BENCH

The rod is drawn through steel dies of successively decreasing diameter until reduced to the proper size. Die block is in circle



AFTER GALVANIZING

The receiving end of the galvanizing operations. There are 20 five-foot reeling swifts for each outfit for galvanizing 20 wires



ROPE-CLOSING, OR TWISTING, MACHINE

On this machine, the largest in the world, the finished wire strands are closed into ropes of large diameter

could be spun. After the erection of the towers and the building of the anchorages, temporary footbridges, or catwalks, were erected for the workmen who spin the cables. The catwalks are supported by four groups of cables, each group being composed of nine galvanized $2\frac{1}{4}$ -inch diameter wire ropes, formed of 6 strands of 37 wires each laid around an independent wire rope center. It is interesting to note that there is as much wire material in the footbridge ropes on the Hudson River Bridge as in the main cables on the Bear Mountain Bridge.

These ropes were manufactured on a mammoth machine that is said to be the largest of its kind in America—if not in the world—which is capable of closing ropes up to five inches in diameter.

To enable the manufacturers to test the footbridge ropes adequately, the world's largest precision testing machine was constructed to Roebbling's specifications. This machine is capable of testing wire cables for tensile strength up to 2,000,000 pounds.

At certain intervals, samples of the suspender ropes—which will hang from the cables and support the bridge floor—are tested on this machine to their breaking point. A strain equal to approximately 1,360,000 pounds is applied before the final parting of the rope is accomplished. This is many thousands of pounds above the necessary specified strength.

In the placing of the footbridge ropes from one anchorage to the other, an entirely new method was adopted. Heretofore the rope, in one continuous length, was made fast to one anchorage, lifted over the tower, then towed across the river on a barge, lifted over the other tower and then fastened in the other anchorage. In

this case the rope was made up in three separate sections, one for each of the land spans, the ends being fixed at the two anchorages, and the other for the main span which is laid on the river bed. These three sections were joined together by means of a special rope link at the bases of the towers, and, at a given signal, cranes operating on the tops of the towers and working in unison, picked the rope up from the bottom of the river and lifted it to a position in a temporary saddle on top of the tower. The footbridge ropes hang at the proper deflection, since they determine the position of the completed main cable.

After the placing of the footbridge ropes, tramway

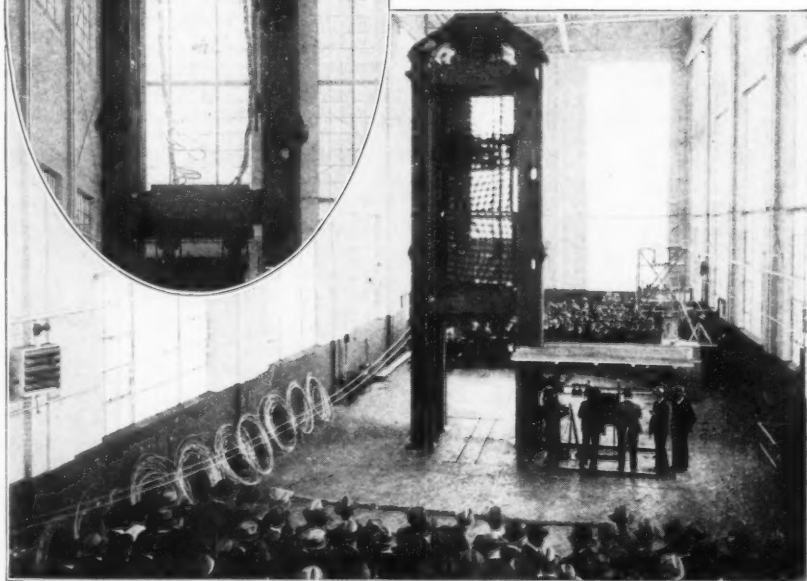
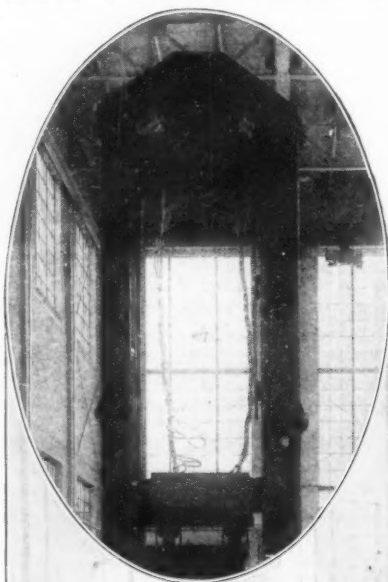
ropes were strung across the intervening gap from anchorage to anchorage, these being used for the transportation of erection materials and for the spinning of the cables. Following this, the wood and steel footbridge sections were placed in position and clamped securely to the ropes; hand rails and

wire netting were then added for the protection of the workmen, and all was ready for the spinning of the main cables. It is interesting to note that after such footbridge ropes have served their purpose, they are reeled and cut into lengths to form the suspender ropes between the main cables and the suspended structure.

There is a complete telephone system between the various centers of activity on the job, making it possible for one man to talk to another, if necessary, from the top of the 635-foot towers to any point on the job. When the Brooklyn Bridge was built, orders and messages were transmitted by means of flag signals.

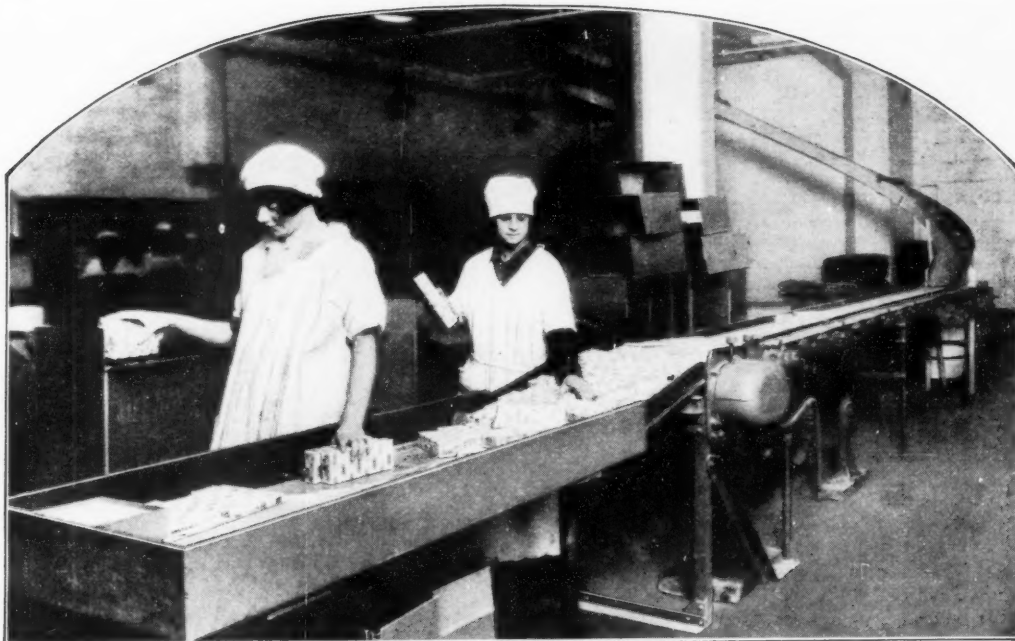
Each tower is also equipped with an elevator running to within 50 feet of its summit. These will be a permanent installation. A staff of engineers is residing in bunk houses on the site so that they are in close touch with developments 24 hours of the day. Observations on the cable deflections according to temperature are made at varying hours since changes in temperature cause the steel cables to expand and contract so that there is an appreciable rise and fall of the roadbed from times of winter cold to those of summer heat. This, of course, all has to be taken into consideration and the necessary information can only be obtained by frequent observations taken with precision instruments and gages.

The spinning of the main cables was started early in November and it is expected that the completed structure will be opened to traffic in December, 1931, thus appropriately marking the centenary of the arrival in this country of a master bridge builder.



MACHINE WHICH SNAPS HUGE WIRE ROPES LIKE THREADS

The largest precision testing machine in the world, capable of exerting a pull of 2,000,000 pounds, in action before The New York Electrical Society. Inset: two ropes breaking in test



MILLIONS OF MINTS READY FOR SHIPMENT

Sealed cartons being delivered at the end of a spiral chute leading from the floors above, where the various

flavors of round tablets are automatically manufactured, wrapped in foil and paper, and packed in sealed cartons

Rebuilding a Broken Business

The Story of the Development Through Research of a Huge Candy Industry

By MILTON WRIGHT

WITH all the thousands of things there are to eat, drink, chew, or roll around in the mouth, the favorite flavor of the Great American Public is peppermint. Just why this is so, nobody seems to know, although there are many theories. One is that it revives childhood memories, peppermint candy for generations being the one kind parents have given their children most frequently. It is the one kind, moreover, that has attracted young children most strongly, because the old-fashioned bright red and white sticks, like miniature barber poles, appeal vividly to the eye.

Then, too, there is nothing backward about the taste of peppermint. When you taste it, you know you are tasting something, no matter how atrophied your sense of taste may have become. Also—and this accounts in no small measure for peppermint's popularity—there is a lasting, penetrating, but pleasant aroma about peppermint that drowns out lingering traces of other things that have been consumed.

Whatever the reason for the popularity of peppermint flavor, the fact is that a great industry has grown up to supply the insatiable demand of the public for mint-flavored confections, an

industry which, for efficient manufacturing methods and clever sales distribution, is second to none. Despite its proportions, however, it is an industry that has developed into the million-dollar class in the last ten years. Only a few months ago a mint confection business was sold for twenty-two million dollars. Yet 15 years ago this business was started with a capital of \$900.

TO learn how candy mints are made, we journeyed to the biggest factory of the kind in the country—the Life Saver plant at Port Chester, New York. As in many modern factories, we found production accomplished by the oldest, simplest, cheapest, and most efficient method man has yet discovered—the gravity process. Up to the roof of the building go the raw materials. Down they come, rolling, sliding, tumbling, falling, passing through this piece of apparatus and that, until they emerge on the second floor, a finished article, wrapped, and in cartons ready for delivery. In all the process no hands have touched them.

The raw materials are sugar and mint flavor—nothing else. Granulated sugar received in barrels is emptied into a conveyor near the receiving

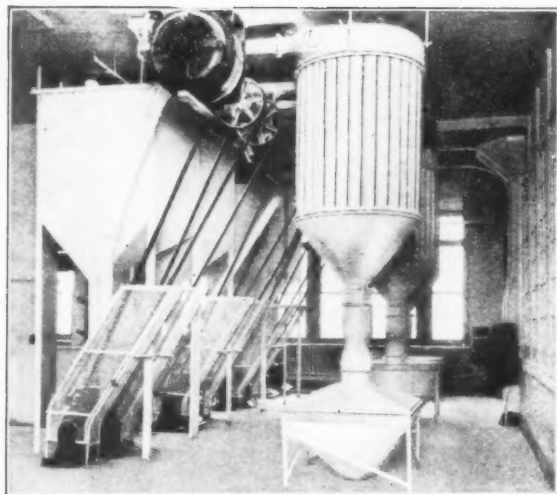
platform on the first floor. A continuous bucket elevator carries it to the roof where it is stored in hoppers until used.

The first manufacturing step is pulverizing the sugar. Standard pulverizers located on the fifth floor do this job. As soon as the sugar is powdered, it drops into mixers on the fourth floor. From the mixers it is put through a special form of granulator which delivers the mass of sugar in the shape of small kernels on to moving belts which lead to elevators. Here the kernels are deposited into drying units, and the whole mass is dried before being deposited into blenders, where the flavoring oils are added.

A completely equipped laboratory is maintained at the plant, where the flavor is prepared and measured out into containers, so that for each batch of 200 pounds of sugar mixture, a uniform amount of flavoring oil is added in order that each batch may be exactly like every other.

From the blenders the mass is fed into batteries of rotary tablet-forming machines on the third floor. To every tablet a pressure of 14,000 pounds is applied, giving it a china-like hardness.

There is an old "wise-crack" to the effect that the manufacturers of Life



PULVERIZING THE SUGAR

Granulated sugar must be powdered in pulverizers before it is ready for the mint-compressing machines

Savers make their money not out of the confection, but out of the hole, or rather out of the sugar saved by having a hole. The fact of the matter is that the high pressure forces as much sugar into a small space as would fill a larger space at more moderate pressure.

After the mints are formed, they are delivered to automatic wrapping and packaging machines, also on the third floor. It took eight years to develop these machines, but now, it is believed, they are as nearly perfect as human ingenuity can make them. Each machine wraps and labels an average of 1000 boxes a day, running at an average speed of 35 to 40 rolls a minute. These machines receive into their hoppers mints in bulk direct from the tablet forming machines. An aligning device turns them on edge and assembles them into rows of 14 each. The assembly completed, each group of 14 is gripped by steel fingers which carry them on to a piece of tin foil which has been cut to the desired length from a big spool of foil beneath the machine. The tin foil is then spun around the candy and the ends twisted.

NOW comes the affixing of the label. This is applied in the same manner as the tin foil, except that to make it secure, instead of twisting, a small strip of vegetable glue is applied along one side. Assembled and wrapped, the packages are deposited on a belt conveyor which delivers them to packers.

At this point on our trip through the factory, we felt impelled to ask a question: "Why not have machines pack the rolls in cartons? It ought to be no more complex than some of the other things you accomplish."

"Machines have been perfected for such a task," was the reply, "but as yet no machine has been devised which will insure each package being laid in the

carton so that the trade mark and flavor name on the label are uniform in appearance and can be seen when the carton is opened. That is a problem yet to be solved by some invention. It means a lot to have a perfect and uniform display of the cartons and their contents on dealers' counters."

With placing the rolls in the cartons, the trip of the sugar down from the roof is not completed. After packing, the cartons are carried on a belt conveyor to a wax sealing machine. Here a paper, waxed only on the outside, is wrapped around the carton and the end

folded in a peculiar manner. The box now passes through an electric heating unit, which melts the wax just enough to cause a tightly sealed package when the wax congeals again.

Through spiral chutes the finished cartons drop to the second floor, where the individual cartons are packed. Those for domestic use are packed into fiber shipping cases and those for export into wooden boxes.

We hunted up the president of the Life Saver Company, Edward J. Noble, who is credited with having created the mint market in this country.

"Why is there so much industry and so much business in such a little thing

as a life-saver tablet?" we queried.

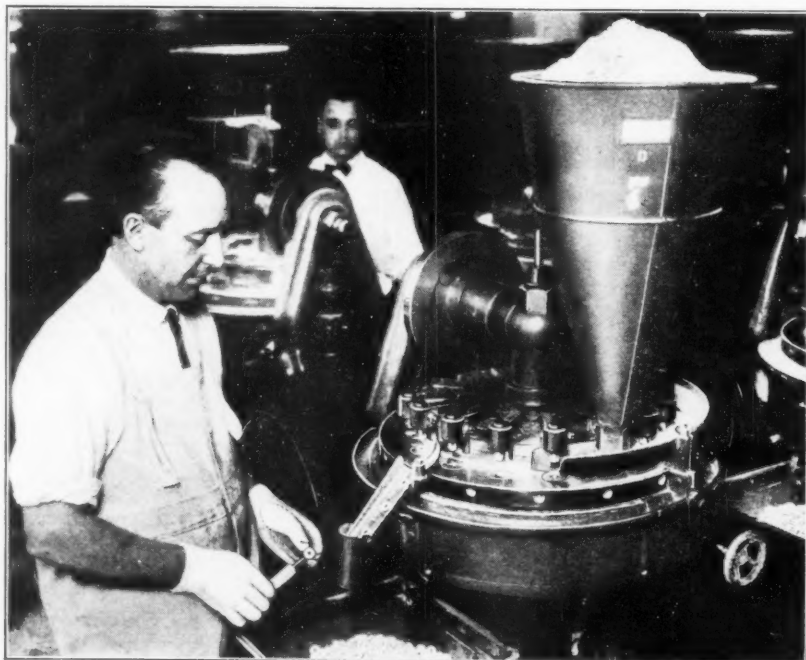
"Well, our sales manager, Mr. M. B. Bates, who is supposed to know about the psychology of such things, says it is due to a national idiosyncrasy," he replied. "It is the result of a trait our ancestors acquired down on the farm. A man used to walk along chewing on a straw. At a later date a lot of people developed the gum-chewing habit—many of them still have it. At a still later date we got the habit of rolling a mint tablet around under the tongue."

"We have heard that when you took over this business 15 years ago it was a failure. Do you attribute your present dominance in the field to the fact that you have improved the quality of your product?"

NOT at all. As a matter of fact, the product is just the same as it always was, even when the public wouldn't use it. A mint tablet is nothing but sugar and flavoring pressed together. From the standpoint of ingredients there was nothing to improve."

By dint of long questioning we finally got at the secret of it all. The mint-tablet industry, we learned, is a child of the candy business, but now grown to manhood and prospering on its own account. Clarence Crane, manufacturer of Crane's and Mary Garden chocolates, had started it in Brooklyn as a summer specialty. It kept his force of workers intact in months which are no time to be boiling sticky chocolates.

Managed as a side line, it was not a paying proposition. Noble and a friend, J. Roy Allen, bought it for a



WHERE THE PEPPERMINTS GET THE HOLE

Compressors moulding peppermint flavored tablets in the familiar "life-saver" shape; a pressure of 14,000 pounds is applied to each, giving it china hardness so it will dissolve slowly

song and with a capital of nine hundred dollars started in business.

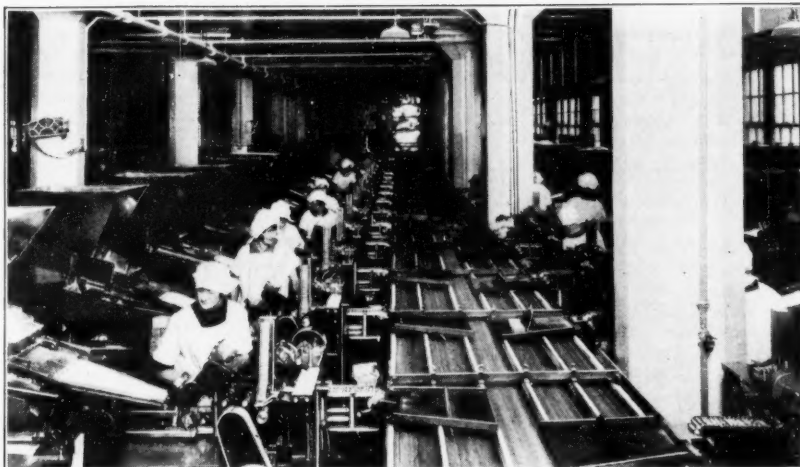
"We had staked all our money, our reputations, and our future on the shape of these confections, but we found the candy stores wouldn't have them," Noble told us. "Dealers had tried them and felt they had been stung. We had to build from the ground up and not only that, but we had to find new ground to build on.

"The mint tablet, we found, was good when it left the factory, but it spoiled after two weeks. A careful study of the matter convinced us that the trouble lay in the packing. The cardboard tube in which the mints were packed absorbed the flavor and in time imparted its own unpleasant taste to the candy. We considered various kinds of wrappers and at last hit upon tin foil. In the first place, a little pressure would seal it; no paste was needed. In the second place, it would hold all the flavor and had no flavor of its own to impart. In the third place, the mints stayed in securely, but came out easily, one at a time, when you wanted them.

NEXT we changed the name. Instead of peppermint we took the name Pep-O-mint. This had a two-fold advantage. It helped to remove the curse from the old product that the dealers wouldn't have, and it gave us the type of name we could adapt to other flavors, like Vi-O-let, or Wint-O-green, or Cl-O-ve, as the business grew.

"So far, our efforts had been directed to the ultimate consumer. Now we had to turn our attention to the dealer. We changed the style of carton. Instead of packing 36 in two rows, we packed 18 in one row. We also designed the carton so that when the cover folded back it formed an easel. This made an attractive display case which the dealer was glad to place on his counter."

"Did the dealers take to the new idea?"



BATTERY OF AUTOMATIC WRAPPING MACHINES

From the pulverizers on the top floor of the factory, through the various steps to the final wrapping, no human hands touch the mints. Here they are being assembled and wrapped

"Not right away. They still identified us with the old article that wouldn't keep. Jobbers wouldn't handle the product. The only thing for us to do was to find new outlets—places where mints had never been sold before. These we found in places frequented by men—cigar stores, bowling alleys, billiard rooms, and the like. It may surprise you to know that 60 percent of the mint tablets made in the country are consumed by men. In all, we developed 17 new outlets. After they had been operating successfully for some time with our product, the candy stores fell into line and our distribution problem was solved."

"But all this took time. Didn't it mean a lot of money going out before any was coming in?"

"No, the business paid for itself from the start. We worked on the principle of taking some profit on every transaction and we never ventured a positive money risk. In the beginning we

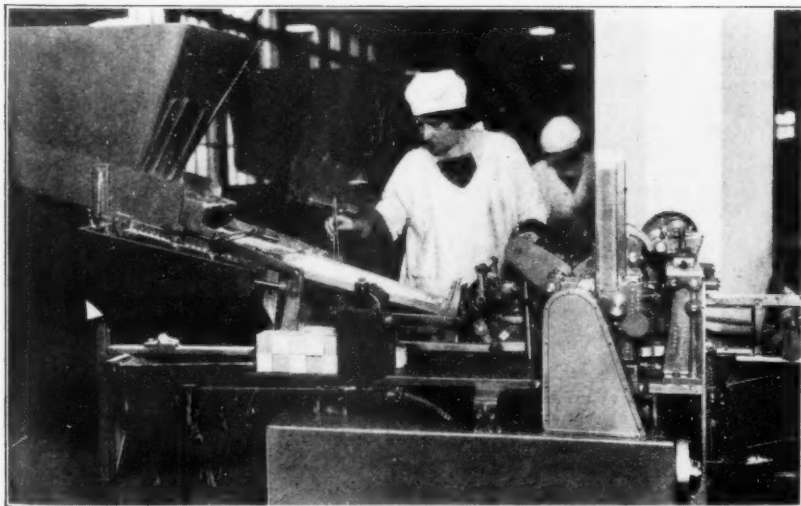
had a manufacturer make the mints for us. Our first order was for 1000 cartons a week. By the end of the first year we were ordering 6000 a week. Our net profit that first year was one hundred and fifty-nine dollars. Then we began to manufacture for ourselves. We progressed steadily until we dominated the industry."

"What steps would you say a man should take when embarking in a new manufacturing enterprise such as yours was when you took hold of it?"

"First, be sure your product is right. Second, be sure the surrounding detail is right. Third, study your market completely. Then go in for scientific manufacturing methods, and after that your success will depend largely upon business ability and hard work."

OF course the candy business is like any other in which the consuming public is the deciding factor; the task of temporarily appeasing a sweet-tooth is mostly a matter of psychology. The imagination of the public has responded to the Life-saver idea because of the characteristic shape and name of the confection. The demand for the little mint with the hole has been sustained and enlarged by astute advertising methods.

The importance of sales psychology is attested by James Somerville, trade commissioner of the Department of Commerce in London, who points out that sales of candy abroad are affected by the fact that residents of the United Kingdom have a decided prejudice against eating in public. For this reason manufacturers encounter difficulty in marketing candy bars of the type popular in America, although there is a vigorous demand for packaged candy put up for consumption in the home, and also for the less noticeable confections that can be eaten anywhere, such as candy-coated chewing gum, lozenges, and mints.



APPLYING THE TIN FOIL AND WRAPPER

Rolling like wheels into the automatic package-wrapping machines, the candies are assembled in groups of 14, rolled in tin foil, and covered with a wrapper denoting the flavor

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

A Mammoth's Deformed Wisdom Tooth

ELEPHANTS, ancient and modern, have had dental troubles for a long time. Fossil mastodon and mammoth teeth have shown pyorrhea, cavity formation (dental caries), abscesses, and now we know they had impacted molars. The tooth shown here is from the largest of all the elephants, the animal standing over 13 feet at the shoulders. This tooth, eight inches high and weighing 25 pounds, was not able to erupt properly, and became impacted and badly twisted. The plates forming the flattened crown, to the right, are at right angles to the plates shown on the left. It is a mammoth's impacted wisdom tooth, discovered in the Pleistocene deposits near Corsicana, Texas.

Life Saving by Mechanical Respiration

THE Schaefer method of respiration for resuscitating victims of apnoea, submersion, electric shock, et cetera, has been in use for many years and has proved its worth many times over. In the past, its successful use depended upon an appreciable amount of training because the method has been usually applied by manual means, and the results, therefore, were influenced by the human element and were not always satisfactory. Now, however, with a new apparatus recently introduced from France, which is easily portable since it weighs but a few pounds, the method may be applied mechanically by any person regardless of his training in resuscitation methods.

The Mechanical Resuscitator, as it is called, consists of a slightly inclined rest upon which the chest of the victim is to be placed, his legs extending outward on the floor to the rear, his head resting upon a curved, leather-covered plate at the top of the incline, and his arms on the two side "saddles" shown in the accompanying illustrations. When he is

placed in this position, wide straps, which are buckled together over the small of his back. The apparatus does not interfere with the use of an oxygen mask which is necessary in cases of monoxide gas poisoning nor does it prevent vomiting or the expulsion from the mouth of any foreign substance which might impede respiration.

In operation, the handle which is



Fossilized impacted molar of a mammoth which shows that these beasts suffered from tooth-ache

connected to the side movable bars is pushed down gently, this action lowering the shoulder supports and lowering the side rods which, in turn, pull down the strap which compresses the patient's lungs. When the pressure on the handle is released, powerful recoil springs lift the side bars and therefore release the pressure on the lungs while at the same time lifting the shoulder supports so that the lungs are allowed to expand and inhale.

When the rhythm of the pumping motion is timed by the breathing of the person operating the lever, the result is that the victim inhales and exhales properly and the likelihood is that he will have a better chance of recovery than if the Schaefer method is applied manually.

As may be seen from the photographs, the apparatus is so simple that even a casual life saver can make no mistake in its operation. The word "chest" on the apparatus (in our photograph, the French word *poitrine* is shown) and the rests provided for the armpits and the head indicate the position in which the patient is to be placed and prevent any possible error.

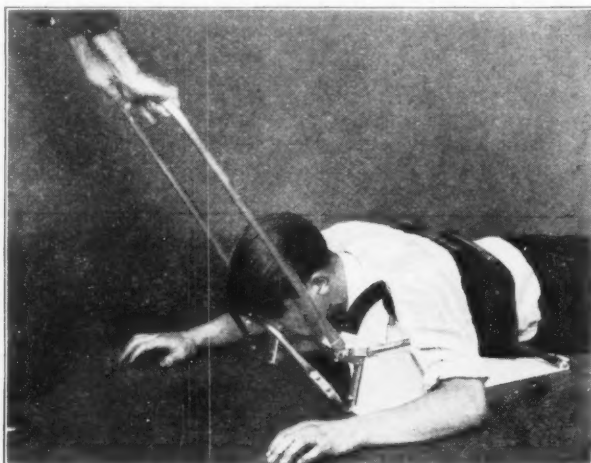
Railway Snow-shed Fire Fighters

THE fire hazard of the extensive wooden snow sheds in the Sierras, exposed from without to forest and brush fires and from within to sparks from locomotives, is responsible for the fact that the railroad owner of the snow sheds possesses a fire department that is perhaps the most unusual in the world. It includes fire trains, lookouts, patrolmen, and alarm systems, all having their well-defined duties.

The fire-train service consists of four trains located one at each end of the snow shed district and two at points of vantage in the shed. Trains are made up of standard 10-wheel locomotives and two water cars carrying from 20,000 to 30,000 gallons of water. This is enough to supply the 300-gallon-per-minute pump for an hour and a half at full pressure. Each one carries a thousand feet of hose and a full equipment of ladders, axes, buckets, and similar apparatus. Engines are kept with steam up at all times and crews are on duty day and night. There has never been a failure of the equipment to stop a fire at the point it was encountered on the arrival of a train. What losses have been sustained, therefore, are measured by the speed with which the alarms are given and responded to after a fire is discovered.



The mechanical respirator described in these columns. Head rest, shoulder saddles, and chest (*poitrine*) pad are shown. Body straps are connected to side bars



The manner in which a patient is placed on the mechanical respirator for treatment. The handle is pumped up and down with a gentle rhythmic movement

For communicating fire alarms to the train, the telegraph was first employed and was later superseded by two independent alarm systems, one like that used in cities, with gongs at the fire-train stations and boxes distributed through the sheds, used for fires only; the other a district alarm system with central office in a concrete fireproof building at the summit of the line, to which all watchmen and patrolmen report at regular intervals.

When it developed that, with watchmen located only in or on the sheds, threatening forest fires could obtain considerable headway before discovery, the necessity for a station from which a bird's-eye view of the

shows the exact location on the railroad. If a blaze is from a small campfire too close to the sheds, word is sent to the nearest section headquarters and men are dispatched to move the campers to a safe distance and extinguish the offending fire. In the case of a fire actually in the shed, the fire trains leap into action on the alarm from the observer, those nearest to the fire going directly to the reported scene and the others closing in as in regular fire department service.

Once well started, the fire demon has been known to consume 3100 feet of snow sheds in 35 minutes, entailing a loss of 1500 dollars every 60 seconds. That is

Fine nut fragments accumulate at the pecan shelling plants. Chemists made experimental pressings of this waste and determined the properties and composition of the oil. This oil is of excellent quality and can be used for making salad dressings or other edible products. It is necessary to express the oil before the nut waste becomes rancid, otherwise the oil would not be edible.

Dried Hog Stomach New, Cheaper Anemia Remedy

DRIED stomachs of hogs may soon vie with livers as the saviors of sufferers from pernicious anemia. This newest



Stone observatory for fire fighters showing snow shed over a railroad in the distance

whole country roundabout could be obtained was apparent. Such a point of vantage was found on the summit of Red Mountain, or Signal Peak, as the Government calls it. The crest of this mountain, 7860 feet above sea level, commands a view of the sheds for almost their entire length. Here a stone observatory has been constructed, and day and night observers keep watch. To determine the exact location of an observed blaze an ingenious device has been arranged. This consists of a transit, mounted on a fixed pier in the center of a bay window, and a map etched on a silver-plated copper plate located on a table in front of the transit. The shed line on the map is inlaid with black enamel and along this line is indicated in different colors each station, tunnel, mile post, signal box, et cetera. Over this map swings a knife-blade pointer attached to, and coinciding with, the axis of the transit.

The operator at night sits in this window in semi-darkness. On seeing a suspicious light, he sights the transit on it and then presses a button which controls a small electric light illuminating the map and the etched line. A glance through the finder shows whether the fire is above, below or in the sheds, and the position of the pointer

why the fire trains race against time when the call comes. Actual records show that very promptly after a fire alarm is turned in fire trains with crews and volunteers are whistling their way to the scene. These fire fighters have been known to stay with the enemy until the headlight was burned off the engine.

As a sample of the accuracy with which even small fires can be located from Red Mountain, the instance is cited of a section foreman who took it into his head to sharpen some track chisels, and, for that purpose, kindled a fire in a small portable forge that was in direct line between the snow sheds and the observatory. This blaze was observed from the lookout and, being apparently in the sheds, the fire train was called, ran two miles, and stopped exactly at the location of the forge before the chisels had been brought to a working heat.

Pecan Oil From Waste

PECAN oil, described by chemists of the United States Department of Agriculture as of very mild, agreeable, and characteristic flavor, is one of the latest additions to the long list of products that are now being manufactured from what were formerly farm wastes.

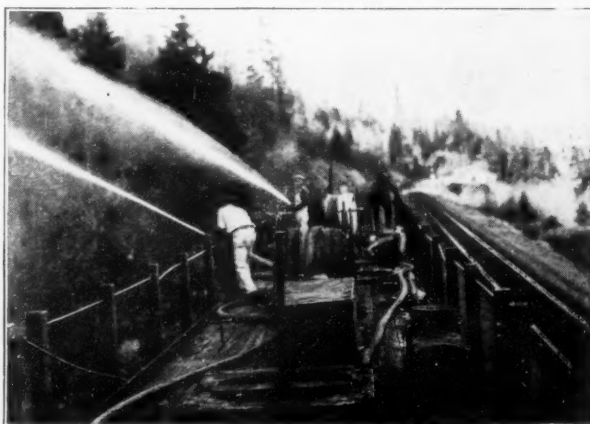
anemia remedy, made from one of the few unused parts of hogs, has just been developed and announced by Drs. Cyrus C. Sturgis and Raphael Isaacs of the Simpson Memorial Institute for Medical Research of the University of Michigan and Dr. Elwood A. Sharp of the Department of Experimental Medicine of Parke, Davis and Company.

An ounce of extract from the dried, ground stomachs of hogs is said to be as effective a remedy in pernicious anemia as a pound of raw liver or three ounces of the most concentrated liver extract yet made.

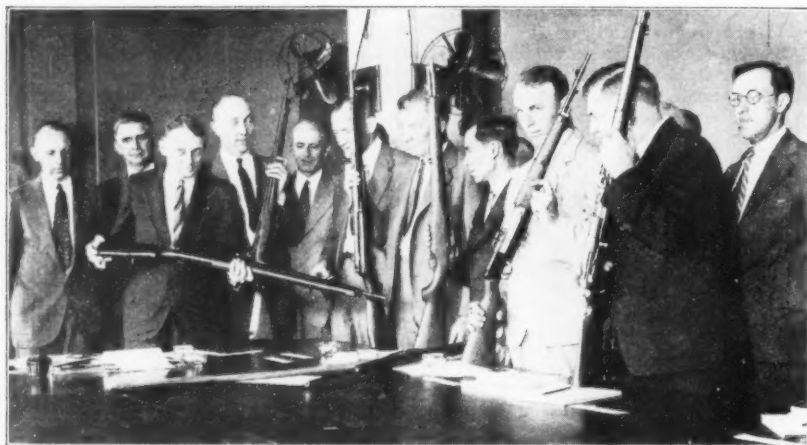
This is the latest step in the conquest of a disease, pernicious anemia, which a few years ago was in the category of the unvanquished ills of mankind. In 1926 it was found that by feeding liver to anemia patients, their red blood corpuscles could be increased. Liver, once the poor man's meat, increased in price rapidly. Then the active principle in liver was extracted so that anemia patients could take small doses of the extract instead of eating large quantities of the liver itself. Now comes the new and cheaper source of the anti-anemia principle which promises splendid results.



One of the fire-fighting trains, called into action by the observer in the station shown in the illustration above



The tank and hose car of a fire-fighting train. Smoke from a fire which menaces railroad property is visible



Over a year ago the United States Government called for competitive designs of semi-automatic shoulder rifles. Recently Army and Navy officials met to test the various designs submitted. Brigadier General George E. Simmons, Chief of the War Plans Division, is here shown examining one of the rifles

The new extract from hog stomach is not yet commercially available. But it will be far cheaper than liver or the costly liver extracts on which pernicious anemia patients until now have been dependent. Hogs' stomachs are largely a waste product, finding only slight use in the production of pepsin. The dried extract is practically tasteless and looks something like sawdust particles. Beef stomach and ox stomach are sold as tripe, which is a familiar food to many. Hog stomach, which has a different structure, is ground and dried to make the new extract.

An immediate increase in the number of red blood cells took place when this dried hog's stomach was fed to patients suffering from pernicious anemia. The increase was even greater than that following liver treatment.—*Science Service.*

Arc-Welded Steel Motor Boats

THE Engineer Corps, United States Army, are now building three arc-welded steel motor boats for use as carriers and tow boats on the Mississippi River and its tributaries. This is the second fleet to be so constructed. The first fleet of seven was launched over a year ago and have been in continuous service ever since.

The launches are constructed entirely of steel, all permanent connections being made by the electric arc-welding process. The over-all length of each craft is 28 feet; breadth 7 feet; and the depth 2 feet 4½

inches; the freeboard, of course, varies with the load, the draught being very little when the boat is not loaded. The boats have flat bottoms, slightly stepped close to the stern and have a rather sharp rise at the bow, effecting a broad, flat prow, similar to the seaplane type.

Each rib of these boats is made from one piece of channel iron, 1½ inch by ⅞ inch by ¼ inch, with the exception of the frame at rear end of forward bulkhead which is of 1½ inch by 1½ inch by ¾ inch angle iron. The two floor stringers are 3 inches by 3 inches by ¾ inch angles punched and bolted in position to each frame, prior to arc welding. Angle-iron stringers are also welded to each side of the channel frames. These stringers are also punched and bolted to the frames to maintain perfect alignment, until arc welded. Deck beams over the fore and aft bulkheads are angles, arc welded directly to top ends of frames. Clamps formed from flat plate are arc welded to every other frame to carry the deck on both sides of the open cockpit.

The bottom and side plates are joined to the frames by short fillet welds about 1½ inches long and approximately 7 inches apart. The bottom is of ¼ inch plate, the sides of ⅞ inch plate and the deck of No. 10 gage sheet steel. The bumpers at the bow of the boat are for pushing barges.

Each boat is to be powered by a 125-horsepower six-cylinder gasoline engine equipped with a reduction gear having a ratio of three to one. With this arrangement the boats obtain an average speed of

approximately 13 miles per hour when running with a light load or no load.

The unique design and construction of these boats is a distinct tribute to the ingenuity and engineering skill of the Engineer Corps. The success of the design and construction of these arc-welded all-steel motor launches, proved after a year's operation, marks a distinct step towards a new method of building power boats which may affect the entire industry. The ability of the electric arc welding process to make a steel hull literally one piece of steel means a stronger, more durable craft free from leakage.

"Going Up to See In Trees"

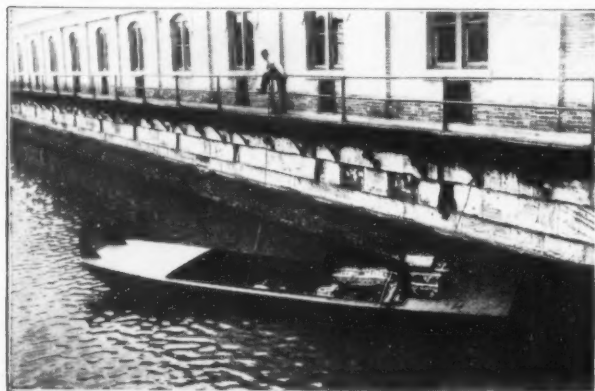
WRITING in *American Forests and Forest Life*, Henry B. Steer recently described a look-out station for



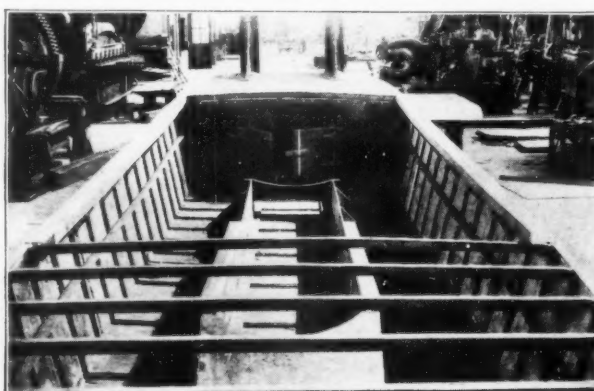
Courtesy American Forests and Forest Life

The spiral "stairway" that leads to the Forest Ranger's lookout station on the top of a 170-foot tree

forest rangers in the Indian Forest Service that is perhaps the most unusual in the country. It consists of a roomy cage seven feet square atop a 170-foot Douglas fir on the Quinault Indian Reservation in



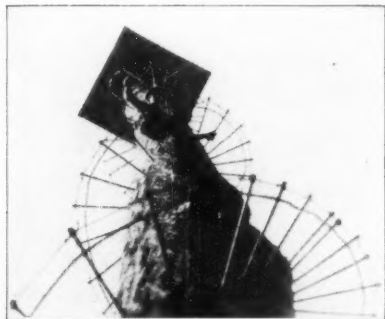
One of the arc-welded steel motor boats built by the Engineer Corps, United States Army, for river service



Interior of one of the arc-welded boats. Ribs, stringers, and beams are channels and angles; the hull is plate

Grays Harbor County, Washington. From this look-out, the ranger has an unobstructed view of timbered and cut-over lands for at least 30 miles in every direction. With high-powered binoculars, he can scan the country for the tell-tale wisps of smoke that mean forest fires.

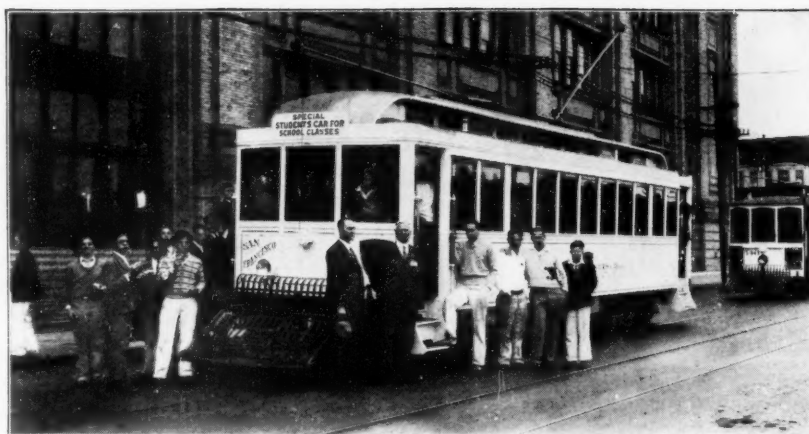
The ranger climbs to his lofty perch by means of a steel rod and rope ladder which spirals the tree trunk and enters the house through a trap door in the floor. The house is glassed in on all four sides, giving an unobstructed view in all directions. In fine weather the windows may be pushed back since they are built in frames which permit them to slide back and forth. The house has two telephones, one connecting with the headquarters camp of a large logging company operating in the vicinity of the station, and the other with the District Ranger of the United States Forest Service at Lake Quinault, for this station overlooks a portion of the Olympic National Forest as well as the major por-



Courtesy American Forests and Forest Life
Up the side of the tree on which the Forest Ranger's station is located, showing manner in which the step-rods were driven into the tree and the wire cable installed

tion of the Quinault Indian Reservation. In case the look-out reports a fire, men and equipment are immediately sent to extinguish it.

The tree is securely guyed by three steel cables, for even a small house seven feet square offers considerable wind resistance when it is 170 feet from the ground. The tree is nearly seven feet through on



To set it apart, the San Francisco educational street car is done in white

the stump and nearly two and one half feet in diameter 170 feet from the ground at the point where the house was built. As a foundation for the house, four railroad ties were set in notches in the tree and securely bolted to the tree trunk. The house was then framed and built upon these ties.

Educational Street Car for Children and Shut-ins

AN attractive parlor street car finished in white enamel, trimmed with gold and fitted with all the latest safety appliances, is operated by the Market Street Railway Company in San Francisco for the use of children, principally for educational purposes and without charge. When schedules will permit, the car is also devoted to unprivileged and shut-in children who need to get around and who, without some such service as this, might never have the opportunity.

Thick carpet covers the floor of the center section of the parlor car, which has plush cushioned wicker chairs and heavy plush window drapes. The end sections have been fitted with the latest type of leather upholstered street-car seats.

Many trips have been made in which technical classes of the San Francisco public and parochial schools have been taken

through the company's car-building plant, car operators' training room, and one of the latest sub-stations where alternating current is converted into lower-voltage direct current for use by street cars. Technically trained men explain the mechanical and electrical processes in the various departments as the classes watch the inside workings of the big machines necessary to successful street-car operation.

Light Uses Third of Electricity in Industry

POWER was generated with about two thirds of the electricity furnished to 20 industrial plants in Detroit, while lamps assisting the sun in lighting the work consumed the other third, according to H. E. Cook and T. G. Ward, electrical engineers. —*Science Service.*

Chemistry Helped "Graf Zeppelin's" Record Flight

MUCH of the romance of industry is epitomized by the recent aerial circumnavigation of the globe by the *Graf Zeppelin*. Underlying the many spectacular features of the epoch-making flight, although very much in the background, is the steady march of modern science, which has made possible the brilliant success of the project.

One of the major problems challenging the ingenuity and resourcefulness of chemists was the problem of refueling the giant ship at its various ports of call in the United States and foreign countries.

The motors of the *Graf Zeppelin* burn gaseous fuel, which is carried in balloons in the interior of the ship, the fuel originally used being Blau gas. This is a very satisfactory fuel gas, because it is about the same weight as air and thus the lifting power of the ship is not affected as the gas is consumed. Since this gas is available in quantities only in Germany, the problem of fueling in foreign countries was put up to chemists of The Linde Air Products Company and the Carbide and Carbon Chemicals Corporation, both units of the Union Carbide and Carbon Corporation, as authorities on the manufacture and use of such gases.

Since nowadays compressed and liquefied gases of many kinds are transported in steel cylinders and tank cars, to serve various industrial needs, with the same facility as the most commonplace commodities, the problem was solved without much difficulty.

(Please turn to page 543)



Courtesy Minnesota Technology

Perhaps the only one of its kind in the world, this spiral approach to the bridge over the Mississippi at Hastings, Minnesota, was necessary in order to eliminate a long approach which would have run far into the business district

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

A Radio Altimeter

THE ordinary altimeter really indicates air pressure only. The height is deduced from a conventional relationship between decrease of pressure and the pressure which applies on the average but not on any particular day. On a hot, low-pressure day, the altimeter may show two or three thousand feet of altitude when the plane is flying at ground level. On a cold day of high barometric pressure, the altimeter may indicate that the pilot is flying underground.

A true height indicator should not depend on atmospheric conditions, but give the real height above the ground at all times. This is particularly valuable when flying in dark or foggy weather, or when

a complete tone cycle from low pitch to high pitch and back again. By counting the cycles of the tone, using half the wavelength of the oscillator as a measuring stick, it is possible to measure the altitude. By means of the meter, graduated from 3000 to 200 feet, the pilot may read his altitude within close limits at any time. The "echoes" indicating height are periodic, becoming stronger as the plane approaches the ground. The periodic characteristics of the echo, and the chance that the pilot would not see the instrument at the instant an echo was recorded, presented a problem which was met by developing a "memory meter." In this instrument the echo is recorded as altitude when it occurs and the meter continues to hold that reading until a stronger echo, indicating a lower altitude, occurs. In approaching the earth, the memory meter gives a continuous indication of altitude.

Instruction in Fog Flying

ON returning from Europe, Major Clarence M. Young, Assistant Secretary of Commerce for Aeronautics recently stated that the Farman system of instruction in fog flying was one of the most interesting things he had noted. Our photograph shows Major Young seated in the "cockpit," so arranged that the occupant cannot see anything but his instruments. The instructor manipulates a control which causes the cockpit to sway sideways or fore-and-aft. The student, "flying blind," attempts to keep the machine on an even keel by the aid of his instruments and controls. This certainly

appears to be a most practical introduction to real blind flying.

Airway Marking

OUR photograph shows the Hon. William P. MacCracken, Jr., former Assistant Secretary of Commerce, and Colonel H. H. Blee, on top of the Commerce Building in Washington examining some airway markers. A committee of the Department made an extended series of flight tests in which markings of various designs, sizes, and colors were painted on large canvases on this roof and tested under a wide variety of weather conditions. Night tests with illumination by various methods were also tried. As a result of these tests, and of a conference at Wichita, certain definite recommendations were adopted.

The markings should be as simple as possible, and have maximum attractive power and visibility under all atmospheric conditions. They should be effective at night.

The markings should give the pilot his position and indicate the direction and distance to the nearest landing field, as well as the general equipment and facilities available at such landing field. They should include the name of the city, and have a meridian marker.

The best results are apparently obtained by using chrome yellow characters on a darker background. The height of the lettering should be from 10 to 30 feet, and under no circumstances less than six feet. Plain vertical Gothic capital lettering is recommended.

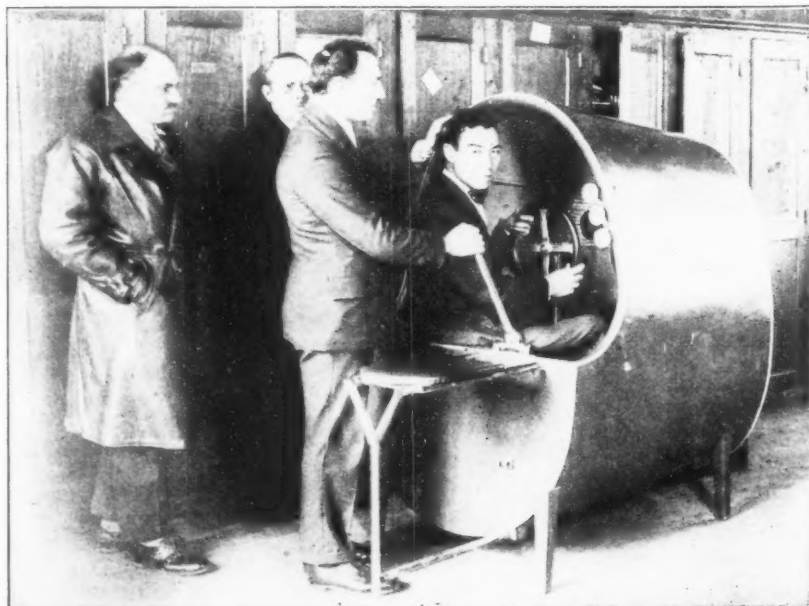


Dr. Alexanderson describing one of his new radio altimeter units

making a landing under similar conditions. There are three principles on which the height altimeter has been attempted: the acoustic method, in which the time for the reflection of a sound from the ground serves to give the height; the capacity method in which two plates on a plane serve as a condenser whose capacity is varied by approach towards the ground; and finally there is the radio method, not yet described in these columns and of real interest. Such a method is being developed by Dr. E. F. W. Alexanderson of the General Electric Company.

A radio wave travels so fast that the time of its reflection from the ground is infinitesimal and cannot be made to give a measure of the height. An indirect method, however, has given positive results.

An oscillating tube circuit is used, one of the type which sends out a wave which may be picked up on other receivers as a squealing note or beat. The echo or reflected signal is picked up on the same set as that which sends out the wave. Every time the airplane changes altitude by half a wavelength, a whistling note goes through



A "cockpit" for instruction in blind flying

How to be *Generous* to a man at Christmas



JUST how does the Gillette Fifty Box qualify as the ideal Christmas gift for a man? Here's how—on these eight counts:

It is practical . . . Man, famous for his practical mind, insists on useful gifts.

Yet he probably wouldn't buy this for himself . . . From long habit, he is used to getting his blades in packs of five and ten. This will be a new and refreshing idea for him.

He'll be sure to use it . . . Blades are a daily necessity in every man's life. The Gillette Fifty Box is the most convenient way to have them.

It is personal . . . It's all to himself, for his own intimate, bathroom use.

It is good looking . . . Packed, as you see, in a metal box, velvet lined, with a spring-hinge cover. Blades are enclosed in brilliant Cellophane.

It is truly generous . . . With fifty smooth, double-edged Gillette Blades in easy grasp, a man can look forward to more continuous shaving comfort than he has probably ever enjoyed before in his life.

It will last well beyond the Christmas season . . . For months his mornings will be free from all thought of buying Gillette Blades.

It is reasonable in price . . . Five dollars buys this *ideal* gift. On sale everywhere.

GILLETTE SAFETY RAZOR CO., BOSTON, U. S. A.



Gillette

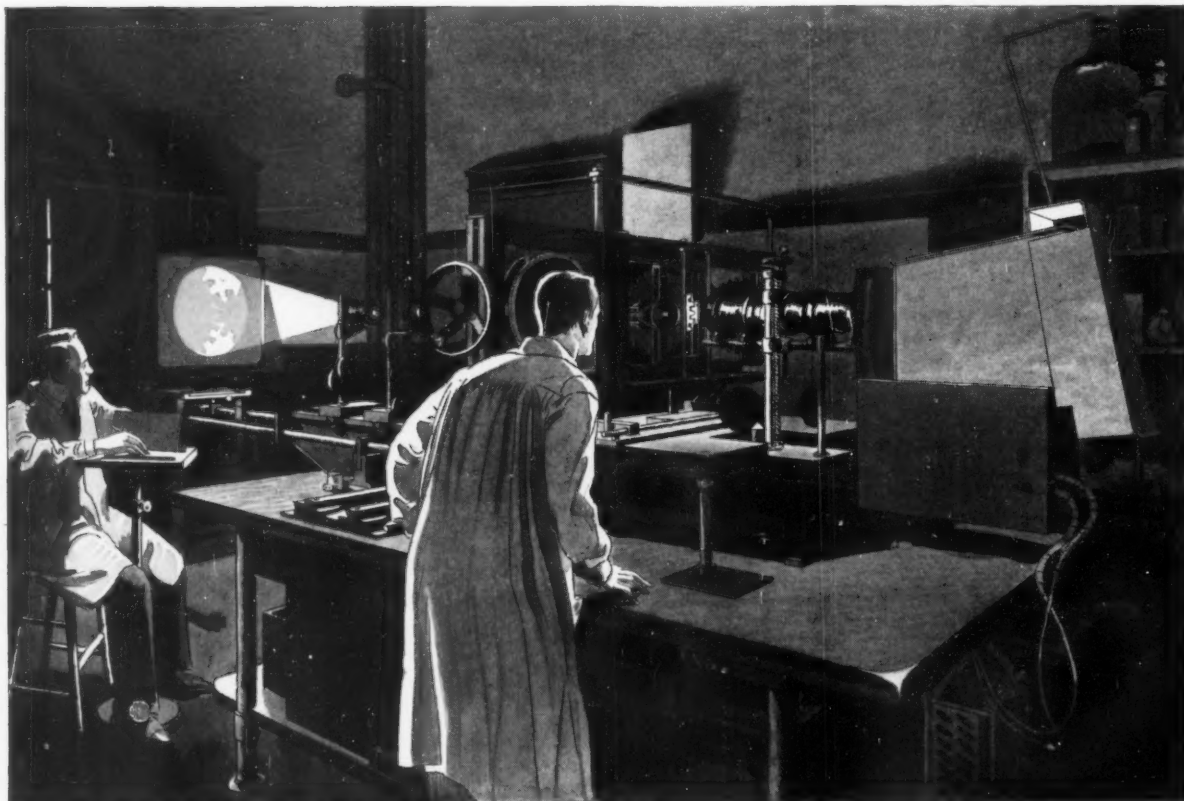


Five Dollars

GIVE HIM SHAVING COMFORT IN ABUNDANCE WITH
THE FAMOUS FIFTY BOX OF GILLETTE BLADES

WHAT WESTINGHOUSE IS DOING IN RESEARCH

DRAWN FOR WESTINGHOUSE BY C. PETER HELCK



WESTINGHOUSE MEASURES INTERNAL STRESSES IN MACHINE PARTS WITH THIS LIGHT-PROJECTION MACHINE

Tomorrow's electrification--on view today

Spend today with Westinghouse research engineers and catch a glimpse of what Westinghouse is doing toward meeting tomorrow's electrical requirements . . .

In a quiet wing of the laboratories in East Pittsburgh, slightly pungent with the fumes of mysterious chemicals, specialists are applying electricity to chemistry. Time alone can tell what new electrical principles they will uncover to aid the industries that depend on chemistry for their advancement.

A cathode ray tube sputters in a dark corner. We know it as the greatest concentrator of energy man has yet developed. Nothing can live in the path of its rays. Westinghouse research is seeking its commercial value.

Here we find men working on new insulators for higher voltages, and new insulators with metallic

glaze making it possible to solder cables securely to porcelain. There they are applying unusual tests to find the dynamic strength of metals, and the amount of permanent distortion they may undergo at high temperatures. Again they are developing inexpensive iron-base alloys to take the place of platinum in tubes and cells.

Now we are among the grid-glow tubes and photo-electric cells. These super-sensitive tubes are the keys to automatic traffic controls, fire and smoke detectors, counting and sorting devices that need not touch their subjects, and switches that will turn on lights automatically when daylight wanes. Thus Westinghouse research is ever looking forward, alert to the future needs and possibilities of every application of electricity—leading the way to new economies for industry and new conveniences and comforts for the home.



Westinghouse



A typical airway marker. See page 528 and left-hand column below

The marking shown in the photograph is typical. The S preceding the pointer indicates that there are seaplane facilities ahead. Within the circle is the rating of the airport. The figure 3 indicates the distance from the airport.

There will soon arise a need for a distinctive mark or symbol to distinguish airway markings from advertising matter. It is important that air markings be placed on the most outstanding buildings or structures, selecting such locations where there is no likelihood of interference from smoke.

In marking metal, shingle, concrete, slate, tile, and similar roofs, the markings may be painted directly on the roof itself, using a good grade of chrome yellow paint of semi-mat finish. Another method is to use markings constructed of painted galvanized iron or other rust-resisting material. When necessary the roof should be treated in such a manner as to afford a dead black background. Raised markings are thought to have a definite advantage, as those placed or painted directly on the roof are very likely to become covered with dirt or soot and in the winter to be blanketed with snow.

There are three general systems of illumination:

- (1) By reflected light, in which either floodlight projectors with spread lenses or industrial reflectors are so arranged as to give a uniform distribution of light of proper intensity over the entire surface of the marking.
- (2) By transmitted light in which incandescent lamps are mounted under translucent glass strips of suitable color arranged to form the letters or symbols.
- (3) By direct light in which the markings are outlined by exposed incandescent lamps or by neon tubes placed along the center lines of the lettering and other symbols.

Illumination by direct light is most effective owing to the greater brilliancy and greater attracting power. Certainly every city which wishes to keep in the foreground will have to give roof marking serious attention. And nothing will give aviation more practical help than such airway markings throughout the country.

Slots and Interceptors

AS we have often pointed out in these pages, the great advantage of the Handley Page slot is that it prevents stalling when the angle of incidence becomes too large. The use of a front slot in conjunction with the ailerons ensures perfect control at slow speeds or high angles of incidence.

One way to use the slot and aileron control is that indicated in one of our drawings, where the aileron is connected by a link mechanism with the slot. With the aileron in its normal position, the slot is only slightly open. When the aileron is down, we want the greatest possible lift on the same side of the wing, and therefore the front slot is open to its greatest extent. When the aileron is up, we want the least possible lift on the wing ahead of the up aileron, and therefore the corresponding slot should be closed.

There is a certain complication in having the slot operated manually, and it is much better to have it open automatically, under the forward movement of the suction on top of the wing. In our second drawing such an automatic action is indicated, and at high angles of incidence the slot is always open. The difficulty involved in this arrangement is that on the side on which the aileron is down, there is not only more lift but also more drag. Hence the machine tends to turn incorrectly for a given bank. We bank to the right and the machine tends to turn to the left.

The interceptor combined with the automatic slot and aileron gives absolutely the last word in lateral control at slow

speeds, and meets this difficulty. Let us imagine that we are flying at high incidence. The slot is open. The depressed aileron compresses the spring, but does nothing to the interceptor, which is a flap on the upper surface of the wing. But when the aileron is pulled up, the interceptor is opened out. Therefore, the drag is increased on the side where the lift is decreased. When the machine is banked to the right, it therefore also tends to turn to the right.

There are many methods by which it is possible to achieve the same end. The result is worth much trouble.

Selling the Light Airplane

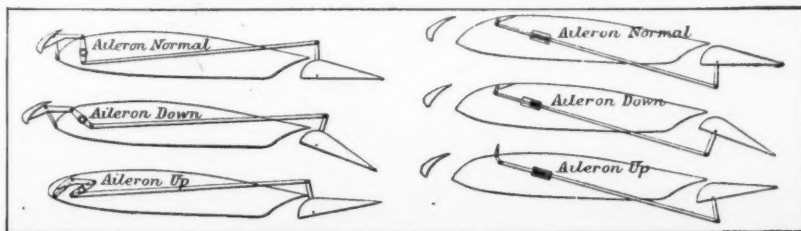
THE National Air Races at Cleveland were a tremendous success in attracting the public's attention to flying, yet we doubt whether the races benefited American aviation so very much because several accidents (probably unavoidable in an event of this character) serve to give the public a wrong impression of aviation dangers. The Cleveland Air Show, on the other hand, was distinctly disappointing. The number of visitors at this show was comparatively small because so many of them preferred to spend their time at the races. Few planes were sold, and manufacturers and dealers were rather disheartened. In the last two years the aircraft industry has been financed on a generous scale by the public and its productive capacity has been enormously increased. It is doubtful whether the market for planes has kept pace with the possible output. The industry is now entering on a competitive phase and the problem of sales has become paramount.

From an article in *Aviation* by Jack W. Duels of the American Aircraft Corporation, it would appear that our airplane distributors are fully alive to the situation and that their sales methods and plans are being improved constantly.

The distributor finds it best to announce his demonstrations to a few selected men. General announcements are apt to bring such a crowd to the airport that sales are actually hindered by excess of public interest.

The demonstration at an airport follows well defined lines. The pilot makes a quick take-off, shows the fast climb of his ship, and then flies across the field at minimum speed to show how slowly and under what perfect control he can fly when need be. After gaining altitude, a low loop and a slow roll are performed. Then come inverted flights and climbs in inverted flight, which are always very impressive. It may be asked why a prospect who will never be required to undertake such maneuvers is given a demonstration of stunt flying. The answer is that stunt flying gives an impression of the perfect command which a pilot has over his plane under all conditions and thus inspires confidence in the prospective purchaser.

(Please turn to page 548)



Illustrating "Slots and Interceptors" above

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Synthetic Resin Improves Lacquers

PYROXYLIN lacquers, to which we owe the lastingly beautiful finish of our automobiles, furniture, and hundreds of other common objects, are basically nitrocellulose, or gun cotton. This very useful product has one disadvantage for this purpose, however, for the film formed upon drying normally lacks luster and adhesion. This has been overcome in modern lacquer production by the addition of resins to the lacquer.

Unfortunately, the materials which are the best solvents for nitrocellulose are the poorest solvents for these resins, and vice versa. With some resins it is very difficult to get a homogeneous solution containing both nitrocellulose and resin, and practically impossible to get a homogeneous film. With any natural resin the lacquer formulator must balance his resin and lacquer solvents very skilfully, and he is constantly confronted with the difficulty that he has, as an ingredient, a material which in many respects is incompatible with nitrocellulose.

Alan C. Johnston, of the Hercules Powder Company, describes in a recent issue of *Industrial and Engineering Chemistry*, a new synthetic resin which appears to be ideally adapted for use in lacquers because it is soluble in nitrocellulose solvents. This latest contribution of synthetic chemistry to lacquer technology is ethyl abietate. Until recently this compound was regarded as a laboratory curiosity, but is now available commercially.

Commercial ethyl abietate has a very slight but agreeable odor. In lacquers the odor is not apparent. Sunlight does not discolor the material itself. When used in a lacquer containing zinc oxide and nitrocellulose, the film does not discolor any more than does a lacquer containing zinc oxide, nitrocellulose, dibutyl phthalate, and dammar gum, both films discoloring to a considerably less extent than films containing zinc oxide, nitrocellulose, dibutyl phthalate, and ester gum.

In ethyl abietate a natural resin has been changed in chemical composition in such a way that, while it still retains its primary resin characteristics and imparts to the film gloss, depth, body, and adhesion, as a resin should, it has ceased to be incompatible with nitrocellulose and has come to have actually a latent solvent action on nitrocellulose.

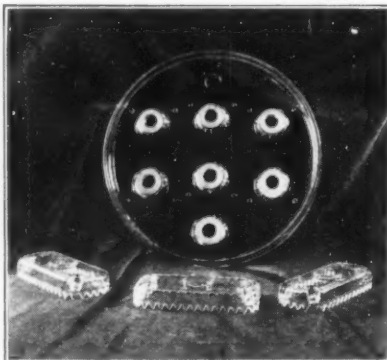
Powdered Fuels for Engines

AFTER many trials and failures, a practical and reliable internal combustion engine appears to have been developed to utilize powdered coal as fuel. Unlike the Diesel engine, states Rudolph Pawlikowski in *Canadian Chemistry and Metallurgy*, it compresses air and fuel at the same time, but keeps them separated until the injection, after the compression. In the Diesel engine, fuel oil must be atomized, heated, and ignited in a small fraction of an engine stroke; the new engine allows a complete stroke for these operations. The engine has been successfully

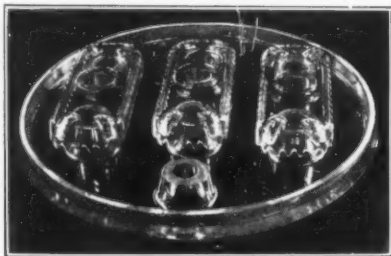
operated on dust of bituminous coal, lignite, peat, wood, charcoal, rice hulls, meal, and coke. Ash disposal, of course, is one of the major problems; but in this engine the ash is so fine that the particles, even if they do get into the oil film, rub on only one of the metal surfaces, not on both. The exhaust is said to be odorless.

Industrial Stills Made of Glass

TRADITIONAL conception of the chemist links him with test-tubes, beakers, and weird assemblies of glassware, but beyond the laboratory, in the actual chemical plant, steel and special alloys dominate the scene and glass apparatus is seldom seen. Yet the many advantages of glass in handling chemicals have long tempted the industrial chemist, and only the mechanical difficulties involved in constructing commercial apparatus have prevented his reversion to this useful laboratory



Above: Special glass plate with its three bonnets. Below: The bonnet-type glass still plate assembled



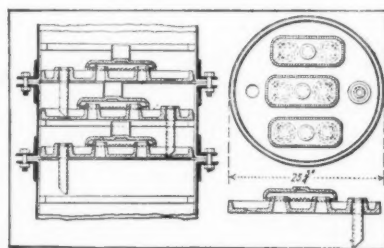
material. Now, however, science has brought such advances to glass technology that the chemical engineer is able to build commercial units out of special glass. A. A. Backhaus made this significant revelation to a recent meeting of the Institute of Chemical Engineers when he described a distilling column, two feet in diameter, designed for the manufacturer of industrial alcohol, in which the intricate and cumbersome parts are all cast in glass.

When this rather radical plan was first considered, the possibility of both the perforated and the bonnet type of distilling plate was considered. Within a short time samples of glass disks 13 inches in diameter,

perforated by sand blast, were submitted. The cost of producing perforations in this manner was prohibitive.

Further experimentation finally resulted in a bonnet-type glass plate design which would be possible from the standpoint of glass practice and at the same time make a practical job for distillation work.

This column has been in use two years for distilling anhydrous solutions containing alcohol and hydrogen chloride. As is well known, corrosion is greatly increased



Drawing of assembled distilling column in relation to a bonneted plate

when erosion occurs simultaneously. In a distilling column the plates, and especially the bonnets, are subjected to the erosion of a violently boiling liquid. Corrosive liquids under these circumstances make a column short-lived. Lead plates used for the job in question lasted only a few months, while the lead lining of the shell showed good life. The use of glass plates has here resulted in a useful combination.

Standardized "Weighting" Practice Adopted by Silk Industry

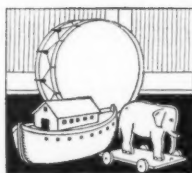
SILK weighting is an art which has its uses and, like many other good things, its dangers. Properly weighted silk has better luster, "feel," and draping qualities than pure dyed silk. The weighting material is cheaper than the fiber, and the makers have sometimes been tempted over much by the demand for cheap silk dresses. Quality has sometimes been sacrificed to price by over-weighting. The industry is striving to correct this by setting up standards of good practice, with the cooperation of the Bureau of Standards.

Silk, as the silk-worm produces it, is covered with an outer layer of soluble gum, known as sericin. This is removed by treatment in a hot alkaline bath of soap with sulfonated oils or silicate of soda. The loss in weight due to this process is about 25 percent. The restoration of this loss is accomplished by successive treatments in baths containing chloride of tin, sodium phosphate, and silicate of soda; but as a well-known textile chemist has recently said, the fiber has no judgment. It will go on taking up mineral matter until it no longer retains properties which we value in silk.

Every dyer knows that weighting "plumps" the silk fiber and improves its luster, the feel of the goods is better, and the dyer says it has a better "hand," the

For toys at Christmas time, for industry all the time ...this grainless wood board

The discovery of a method to make wood grainless is revolutionizing many industrial processes, is giving manufacturers a new material with which to improve products and reduce costs. Perhaps you, too, can profitably use this grainless wood. A sample and the Presdwood booklet are yours for the asking. Both are FREE.



FOR CHILDREN'S
CHRISTMAS TOYS

Now tiny tots can play with wooden toys that will not splinter. Motor truck bodies are made strong and smooth with a material that neither cracks nor splits. Glistening concrete walls of towering skyscrapers require practically no

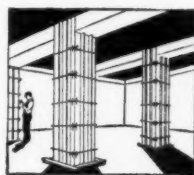
hand smoothing because of a perfect, smooth board that lines the forms. All these developments, and scores of others in manufacturing and building, are possible today because of the grainless wood board, Masonite Presdwood.

Manufacturers find that Presdwood has many properties which adapt it to production methods. Builders find its smooth surface, its uniform $\frac{1}{8}$ th inch thickness, and its broad four foot by twelve foot pieces ideal for paneling, display booths, closet lining, breakfast nooks, and for lining ventilator and elevator shafts.

Easily worked—in factory or home

While the grainless nature of Presdwood is perhaps its most remarkable feature, it is far from the only property which makes Presdwood popular. This grainless wood is hard, smooth, strong, and dense. It never harms fine tools; it can be punched, die cut, milled, or sanded; it is also ideal for the home mechanic who has little to work with but a hammer and saw. And when an article is completed it can be left just as it is because of Presdwood's natural beauty and resistance to moisture, or can be given any commercial finish.

This grainless wood is used in radio cabinets, tension boards for loud speakers, beds of portable billiard tables, book cases, kitchen cabinets, show cases, and china closets. It makes strong shipping containers, weather resisting road signs, light partitions, durable work bench tops, and attractive novelties such as bedroom screens, fire screens, and trays.



FOR LINING
CONCRETE FORMS

Lines concrete forms

Building contractors reduce labor costs on concrete work as much as 40 per cent when Presdwood lines the forms, for the face of Presdwood leaves the concrete perfectly smooth so that the process of polishing with carborundum bricks can be entirely eliminated.

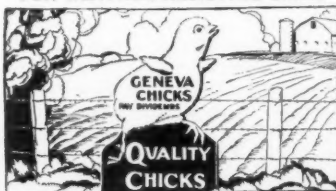
Every manufacturer, builder, and home mechanic should read the fascinating story of wood made grainless. It is the record of a scientific experiment with live steam at 1,000 pounds pressure—an experiment which revealed a way to make grainless wood commercially.

The Presdwood booklet tells this story, lists 80 uses for this grainless wood, and tells how various finishes should be applied. The booklet and a sample of Presdwood are yours for the asking. A postcard brings them.

MASONITE CORPORATION

Dept. 744, 111 West Washington Street
Chicago, Illinois

FOR WEATHER RESISTING SIGNS



© 1929 M. C.

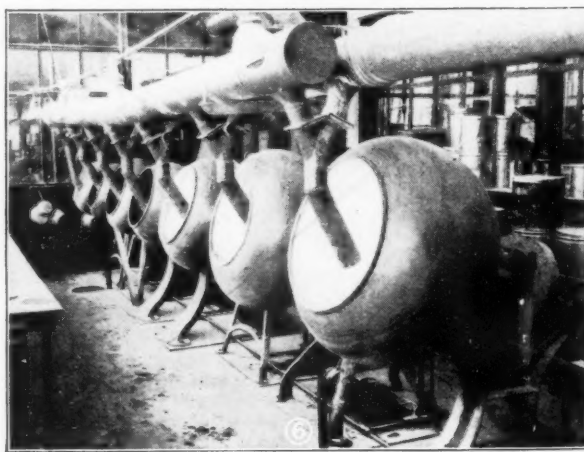
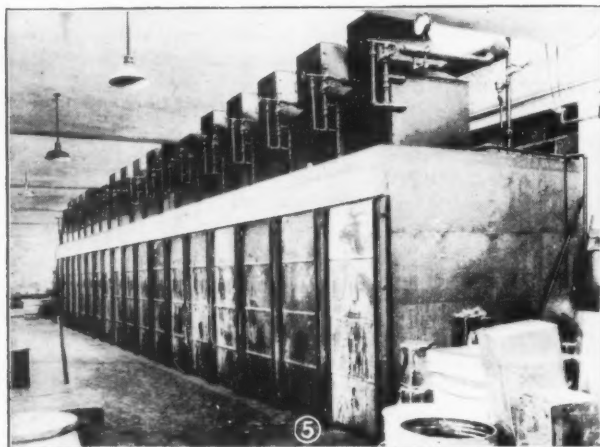
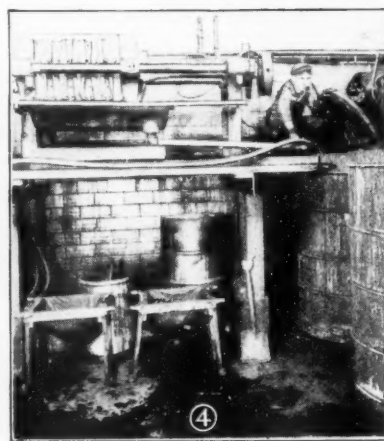
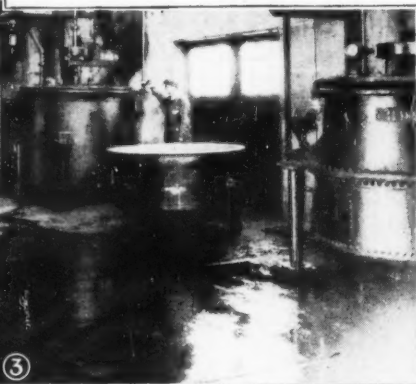
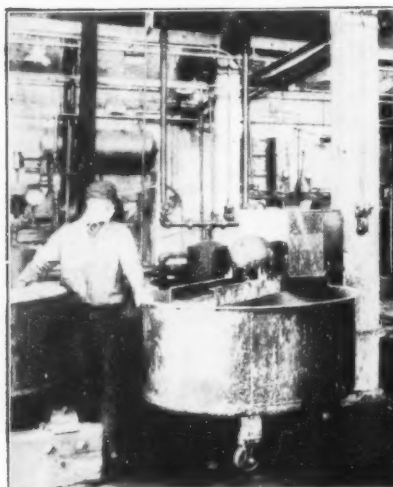
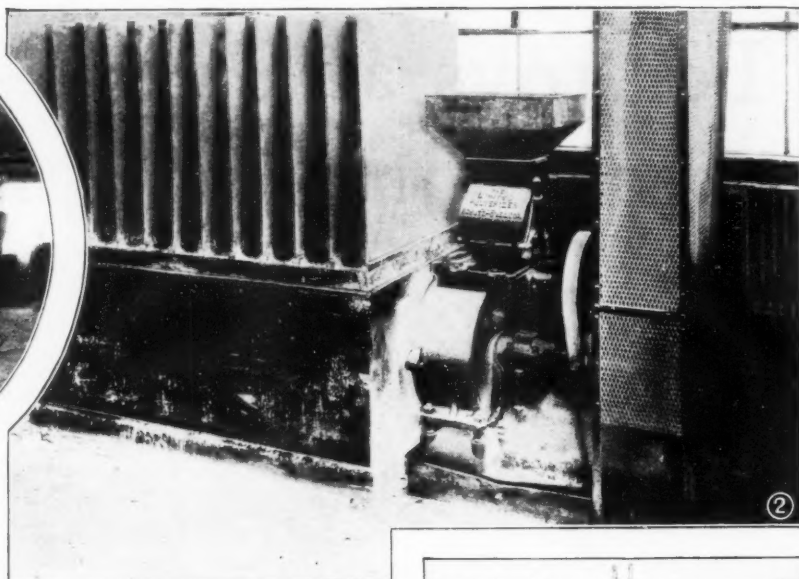
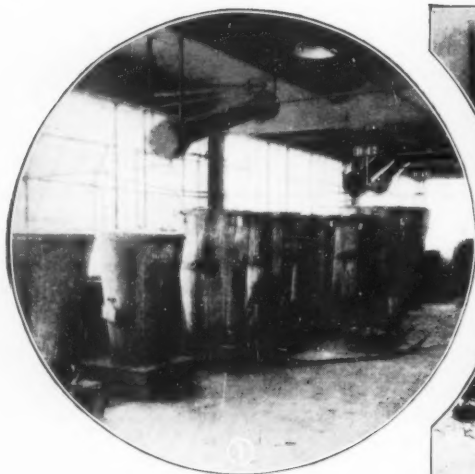
Masonite

PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION

FOR STURDY SHIPPING CONTAINERS





Photographs courtesy Chemical and Metallurgical Engineering

EVERYTHING FOR THE MEDICINE CHEST

increased weight also gives a better effect in draping. All of this results in a steady demand for silk which contains enough mineral matter to make it weigh 50 percent more than in the raw state.

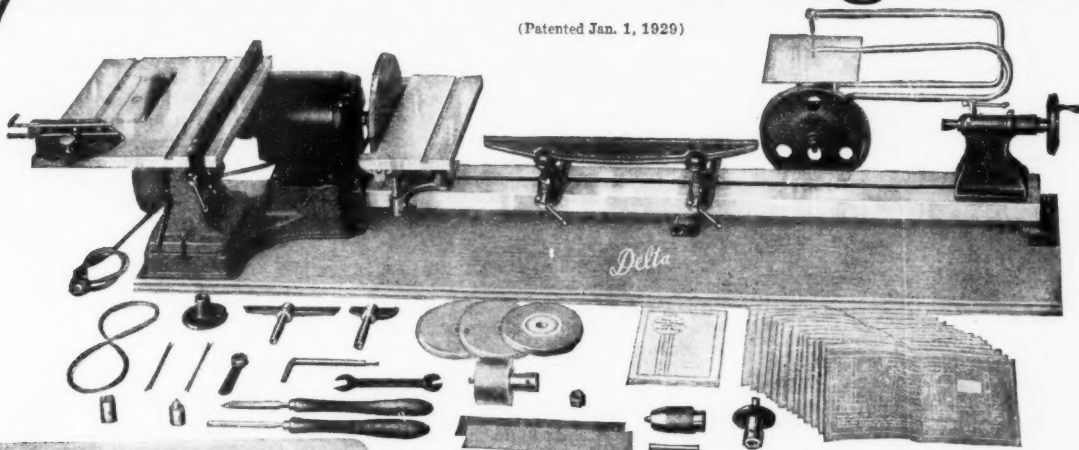
Silk is a very strong fiber and one would naturally expect the weighting to reduce its strength, but recent investigations show that moderate weighting actually increases the tensile strength of silk. It only begins to decline when the amount of mineral matter is enough to raise the weight of the fiber more than 50 percent.

(Please turn to page 534)

THIS plant of the Abbot laboratories near Chicago is notable for the wide variety of its pharmaceutical products: more than one thousand substances are made here for use in the medical profession. (1) Percolators used for extracting the active principal in drugs, from vegetable sources, by means of solvents. (2) Grinder and receiver for preparing the ingredients of effervescent salts, which are purified by crystallization, ground and sifted. (3) Apparatus for manufacturing neomal, barbital, and other hypnotics. The ingredients are mixed in centrifugal glass-lined kettles, a steam-jacketed kettle, and an oil-heated kettle. (4) Part of the equipment used to manufacture antilavine and proflavine sulfate. (5) A battery of driers used for many pharmaceutical products. Dust is removed from the incoming air by the oil filters on top of the drying chamber. (6) A battery of tablet and pill coating machines. The coating not only hides the unpleasant taste of the pills, but also "case hardens" them so that they will not disintegrate until swallowed by the patient.

Announcing "Delta" Woodworking Units

(Patented Jan. 1, 1929)



"Delta" Electric Handi-Shop

A complete Motorized Workshop for craftsmen, including all necessary equipment for Circular Sawing, Wood Turning, Scroll Sawing, Sanding, Drilling, Grinding and Buffing.

Practical Design — Dependable Quality — Plus Many Exclusive Features —

that's what you find in every woodworking unit bearing the Delta trademark. Craftsmen, artisans, farmers, mechanics—all who use wood in their daily labors or spare-time hobbies—are delighted with the sturdy construction, splendid efficiency, and moderate cost of Delta equipment. They appreciate keenly such exclusive constructional features as the Patented Tilting Tables, Automatically-oiled Bronze Bearings, Heavy U-Shaped Lathe Bed, Circular Saw Raising Lever in the Handi-Shop—the new Welded Steel Stands, Graduated Fence, Practical Rip Gauge, Graduated Miter Gauge, and the convenient arrangement, in the new Delta Jointer and Circular Saw Units, which can be used with your motor, if desired.

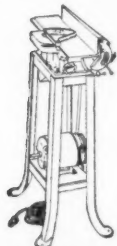


Combination 4-inch Jointer and 8-inch Circular Saw Unit

mounted conveniently on welded steel stand. Both machines can be used together or separately. Furnished with or without motor.

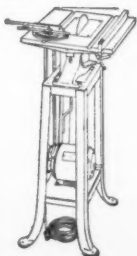
8-inch Circular Saw Unit

mounted separately on sturdy, welded steel stand. Furnished with or without motor.



4-inch Jointer Unit

of new, practical design. Mounted on stand. Furnished with or without motor.



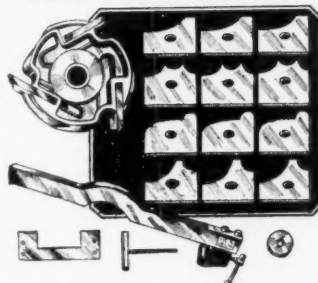
10 Day Trial Easy Terms

For complete details and full description of the new 1930 Delta line, send coupon for FREE illustrated literature. Shows many items of interest to those who work with wood. You will learn, also, how you can try any Delta equipment for 10 days under actual working conditions at our risk. Choice of three convenient payment plans. Mail coupon TODAY!

DELTA SPECIALTY CO.

Division of
DELTA MANUFACTURING CO.,
1661-67 Holton St. Milwaukee, Wis.
DEPT. S-129

New "Delta" MOULDING CUTTER



Cuts Over 50 Moulding Shapes With Only 4 Sets of Blades

High speed blades produce over 10,000 cuts per minute at 3500 R.P.M. Blades require no individual adjustment. Quickly and easily locked in position. Special guide fence. Unusually low price.



DELTA SPECIALTY COMPANY, Dept. S-129
Division of "Delta Manufacturing Co."
1661-67 Holton St., Milwaukee, Wis.

Please send me FREE, illustrated literature describing 1930 model "Delta" Woodworking Units. Also details of 10 Day Trial Offer and Easy Payment Plans.

Name.....
Address.....

Elasticity declines at lower weights than tensile strength. A fiber which showed 26 percent stretch after boiling off, but without weighting, showed 28 percent stretch when weighted 30 percent above par, 24 percent at 40, and 20 percent at 50 above par.

Quality of silk in relation to the conditions of its use requires much further study. There is good reason to expect that its resistance to abrasion or wear will be found better after proper weighting than before. This is an important factor. It has been aptly said there is no reason to suppose that a silkworm has a lady's dress in mind when performing the synthesis of his useful product. Its adaptability to human uses is an accident.

Ethanolamine Soap Has Many Uses

WE see and hear a great deal about the remarkable properties of certain brands of soap in connection with youthful complexions, skins you love to touch, and so on, but the chemist has gone the advertising man one better by developing an entirely new kind of soap in which neither "fat" nor lye, the traditional raw materials of soap production, are used. This new product is known as ethanolamine soap because it is made from a fatty acid and ethanolamine. Ralf B. Trusler, an industrial fellow at the Mellon Institute of Industrial Research, describes this "synthetic" soap in the current issue of *Industrial and Engineering Chemistry*.

The ethanolamines (there are three in the family—mono-, di-, and tri-) are synthesized from ammonia. There are three possible homologous types of ethanolamine soaps, depending upon which one of the three ethanolamines is used. However, for technical purposes, a mixture of the three can be used advantageously, because they are quite similar in their properties. Any of the three ethanolamines as well as technical "ethanolamine" combines readily with fatty acids to produce soaps.

Ethanolamine soaps are pale yellow to reddish brown, depending upon the purity and color of the fatty acids employed, and, generally speaking, all these compounds have an agreeable, soapy odor. Those made from the higher fatty acids, such as oleic and steric acids, are soluble in a great variety of organic solvents, which is one of their unusual and outstanding properties. They are dissolved readily by benzene, toluene, and similar compounds. Turpentine, alcohols, glycols, glycerol, ketones, and

many aldehydes are excellent solvents for these soaps. It is surprising to note that even heavy petroleum products, such as lubricating oils and petrolatum, will dissolve quite appreciable amounts. This is particularly true of the oleate. In most cases, excepting the heavy oils, the ethanolamine soaps are soluble in the solvents in all proportions, yielding transparent solutions.

Ethanolamine oleate possesses striking emulsifying ability in promoting oil-in-water emulsions.

It has been found that small amounts, in the proximity of 0.3 to 1 percent of these soaps dissolved in lubricating oils, either increase their viscosity or cause them to gel. In many instances heavy oils can be rendered non-running and given increased consistency, and appear to be suitable for pressure oiling systems (not for internal-combustion engines) and for cup and gear greases.

A convenient and efficient means for removing oil and grease from articles and clothing can be made by dissolving about 10 to 20 percent of the oleate in a convenient solvent, such as naphtha, carbon tetrachloride, ethylene dichloride, and the like. A solution such as this has been successfully used in cleaning greasy walls, woodwork, mechanisms, automobile bodies, and parts covered with grease and oil, by brushing or rubbing it over the surfaces to be cleaned. After the solvent has evaporated, the grease and oil can be often completely removed by washing with water, because the grime is removed as an emulsion as the soap is taken up by the water.

Ethanolamine oleate in the presence of moisture has a marked softening action upon starch, sugar, and other non-greasy substances, thus facilitating the cleaning of garments. In fact, much of the laborious spotting-out operation usually experienced by dry-cleaners can be avoided by using this soap in the regular dry cleaning operation. For cleaning felt and wool hats, where the soap in naphtha is applied by hand, particularly good results have been obtained.

Carbon Dioxide Gas Used to Fight Fire

CARBON dioxide, the gas which we exhale and which gives the sparkle to our soft drinks, has begun the conquest of a new realm—that of fire fighting. Because it is comparatively easy to liquefy and is safely handled in that condition, its fire-blanketing property is useful in

certain conflagrations. One of the illustrations shows a fire in a large lacquer dip tank being extinguished through the use of the Alfite system, which utilizes carbon dioxide as the extinguishing agent. This photograph was taken just at the moment when all flame had disappeared and the fire was out. The fire was extinguished in seven seconds, after being allowed to burn for two minutes.

In the other illustration a lacquer fire is being extinguished by the "fireman" who is directing a blanket of carbon dioxide over the flames. This system is called "Fyre-Freez" because, in addition to the blanketing effect, some of the effectiveness of the system is attributed to the chilling effect of the carbon dioxide. Because of the high pressure under which it is stored the CO_2 falls on the fire at a temperature far below zero.

Fish Fussy About Salt in Their Water

NEARLY everyone has "felt like a fish out of water" but it is only recently that scientists of the United States Bureau of Mines have looked into the question of how a fresh-water fish feels in salt water, and vice versa. Here is a typical example of the strange fields into which industrial and research chemistry leads its votaries, for this particular investigation, conducted by L. Schmidt and J. M. Devine, had for its objective the discovery of how the wastes from oil fields can be disposed of harmlessly. This led them to the consideration of the effect of soluble chlorides, run as waste into streams, upon the fish.

No general statement can be made regarding the maximum concentration of salts in which fresh-water fish can live, for this depends on the species of fish as well as on other factors. The top minnow, *Gambusia*, may be plunged directly from fresh water to sea water without any apparent ill effects. Again, such typically fresh-water fishes as the black bass, the brook trout, and the carp, are known to live and thrive well in brackish and even salt water under natural conditions where the fish is free to choose its own environment. On the other hand, salt-water fishes may be killed by a too-great saline concentration.

Calcium chloride seems to be much more lethal in its effect than sodium chloride. According to the Bureau of Fisheries, a 1 percent solution of calcium chloride

(Please turn to page 545)



Fire in a large lacquer tank, which fills the building shown at the left, photographed just as the flame was



extinguished. At the right, carbon dioxide at a temperature several degrees below zero blanketing a lacquer fire



The Review of Reviews

Is the Leading
News Magazine
of Today

It Brings You
Reading That's
a Real Mental
Eye-Opener

It's a
Crystallizer of
View Point—
It Gives You
the Assurance
to Express an
Opinion

6 REASONS

Why you'll like the Review of Reviews

- 1 **BECAUSE** — It brings you all the worth while news, both here and abroad. Once a month the *Review of Reviews* gives you the true, sifted substance of all that's going on in the world. A clarifying account, impartially told, of national affairs, political trends, social problems, foreign affairs and trade relations, activities in the world of business and finance — "like a monthly chat with an old friend who knows all about everything."
- 2 **BECAUSE** — It gives you more than the news. It gives an interpretation of the news. Once a month the *Review of Reviews* clarifies the disconnected, confusing news story you get through your daily reading. It interprets the news in practical terms. It makes you see our busy world in one complete picture.
- 3 **BECAUSE** — Each issue contains Dr. Shaw's intensely interesting editorials on subjects of national importance. Each month an article by Frank H. Simonds, the well known authority on European affairs.
- 4 **BECAUSE** — It's a digest of other magazines. You can't read them all. Anything that is published in periodicals or books that is too good to miss will be passed on to you in brief in the *Review of Reviews*. It's a time-saver for busy men and women who wish to keep up with the times.
- 5 **BECAUSE** — It acquaints you with the outstanding personalities of the day and has departments to cover every field of activity, *Finance, Art, Travel, Science, Books, Religion, and Sport.*
- 6 **BECAUSE** — It is the most inexpensive way to carry on a continuous education and no one can afford to stop educating himself.

"AN INTELLIGENT UNDERSTANDING" — Your interpretations of events constitute a unique contribution toward an intelligent understanding of history in the making. — **Charles M. Schwab**, Chairman of the Board, Bethlehem Steel Corporation

"INTIMATELY AND GRACEFULLY AND UNDERSTANDINGLY" — I have read the *Review of Reviews* in its new form from cover to cover. It is a wonder to me — always — to observe how intimately and gracefully and understandingly you present the outstanding characters and affairs of the wide world from month to month. — **Irving Bacheller**, Author.

"WELL-BALANCED, HIGH-MINDED" — I have been long accustomed to looking forward every month to the well-balanced, high-minded, and forward-looking comments which you have fortunately been able to make year after year for several decades. — **Edwin R. Seligman**, Department of Political Science, Columbia University.

ment of Political Science, Columbia University.

ALWAYS HELPFUL — I never turn to it without obtaining both light and leading. — **John W. Davis**, Democratic Nominee for President, 1924.

"A SOURCE OF PROFIT AND PLEASURE" — For many years the *Review of Reviews* has been a source of profit and pleasure to me and I would like you to know that, as one of its long time readers, I feel grateful for its change in form. It is as easy to handle as before, and a joy to read. — **Col. Edward M. House**, Author and Diplomat.

"ONE OF OUR INDISPENSABLE MAGAZINES" — The *Review of Reviews* has always been one of our indispensable magazines ever since it was founded. You are to be congratulated in making it more indispensable — if that is possible. — **Charles A. Beard**, Author.

THIS COUPON
will bring you
a six months'
trial
subscription
for
\$1

Review
of Reviews
Corporation
55 Fifth Ave.
New York City

I enclose \$1.00 for a
special Six Months'
Trial Subscription to the
Review of Reviews.

Name

Address

SA 12-29

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygeia

Liver and Iron in Anemia

YEARs ago when girls lived largely an indoor life, there was a great frequency of a disease called chlorosis, or the "green sickness." As costumes have changed to permit more freedom of motion and as women have come to take up outdoor sports, this disease has practically disappeared and is rarely seen by a modern physician. The chief symptom of chlorosis is the deficiency of red blood cells and of the red coloring matter in the blood, producing a condition called secondary anemia. It used to be the custom to treat secondary anemia by giving iron, which has the value of stimulating the formation of the red coloring matter; small doses of arsenic were used with the idea that they aided the bone marrow in producing red blood cells.

A few years ago investigators in the laboratory of the University of Rochester, New York, found that animals could be caused to have some new blood very promptly after they had been submitted to hemorrhages, by feeding them with meats. Of all the meat substances available, liver and kidney seemed to be superior. It was generally thought that this action was due to the fact that these tissues are rich in iron. On the basis of this work, however, Boston investigators proved that extracts of liver had some special function in stimulating the formation of blood and in preventing the destruction of red blood cells in the body. As a result of their work, pernicious anemia, formerly an incurable disease, has been brought under control.

It was thought at first that the feeding of liver would be equally satisfactory for controlling the secondary anemias, but liver seems to have failed somewhat in this regard when used either in the form of raw liver or in liver extract. Recently, Drs. Chester S. Keefer and C. S. Yang of the Peking Union Medical College in China studied the question of secondary anemia

to find out whether liver alone or iron alone would be as effective as both used together in cases of secondary anemia. They tested their methods on persons recovering after blood transfusions, after surgical operations and hemorrhages, and after hookworm disease. In hookworm disease there is an anemia which apparently is due to the fact that the person with hookworm seldom eats enough of anything and certainly not enough of the vital nutritive substances.

The investigators found that iron was effective in bringing about increased regeneration of the red coloring matter in the blood in patients with secondary anemia. When liver and iron were given in combination, the increase was more rapid than when either was given alone. The results were particularly noticeable in the cases of persons with hookworm infestation.

Eye Examinations of Children

PRACTICALLY every modern school now arranges for regular examinations of the eyes of children to make sure that the child is not backward in its work because it does not see the blackboard or the books. In many schools the system has been so thoroughly worked out that it is a relatively simple matter to test a great number of children.

Investigations by the National Society for the Prevention of Blindness have shown that there were from six to twelve percent of children in schools who have defective eyes. Doctor Frank H. Rodin is convinced that such examinations should be made by the regular medical officers of the schools and that they can be assisted in the routine by the school nurse and the teachers.

In the routine examinations, children are examined in groups of ten. First the doctor looks over the eyes to make sure that there are no visible diseases. For small children, the Snellen chart with the letter E is commonly used. The child is asked

to read the second line, known as the 20-20 line because normal vision demands the ability to read this line at a distance of 20 feet. If the child cannot read this line, it is then asked to read the top line and then the smaller ones.

In most instances when defective vision is found, the child is referred to a specialist in diseases of the eye, in order that it may be properly treated.

Ringworm of the Feet

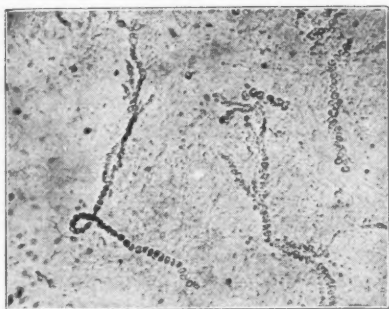
MORE and more as the gymnasium, the swimming pool and the golf club have spread throughout the land, infections of the feet have become prevalent. The most widespread of infections is the ringworm [See also page 442, November 1929 SCIENTIFIC AMERICAN.—Editor] which causes breaking down of the skin, particularly between the toes, itching, and in some cases such destruction of the tissue as to produce pain and secondary infection.

Among the measures used to overcome such infection are scrubbing of floors with antiseptic substances, insistence on the use of individual slippers or paper slippers by all who use the showers, and the application of measures directly to the infection. Unfortunately, it is quite easy for people with ringworm of the feet to become re-infected from their own clothing, unless it is thoroughly washed when it is removed.

Recently, Drs. C. M. Williams and E. A. Barthel have shown that it is possible to believe that one has recovered from the condition and then to become re-infected from very small foci of infestation from around the toe-nails. Indeed, they found by examination of clippings of the nails and of the feet of many people who were infected, that almost every one of them still had some remnants of infection about the nails. When the scrapings are examined under the microscope after being suitably prepared, the organism that causes the trouble can easily be seen. Obviously it is



Proper eye examination should be a regular part of school work



Above: The organism that causes ringworm of the feet. Below: Typical infection of the fifth toe-nail and thickening of the cuticle of the third nail in a case of ringworm of the feet



important to be sure that every possible foci of infestation have been removed before the individual can consider himself cured.

Nervous Baldness

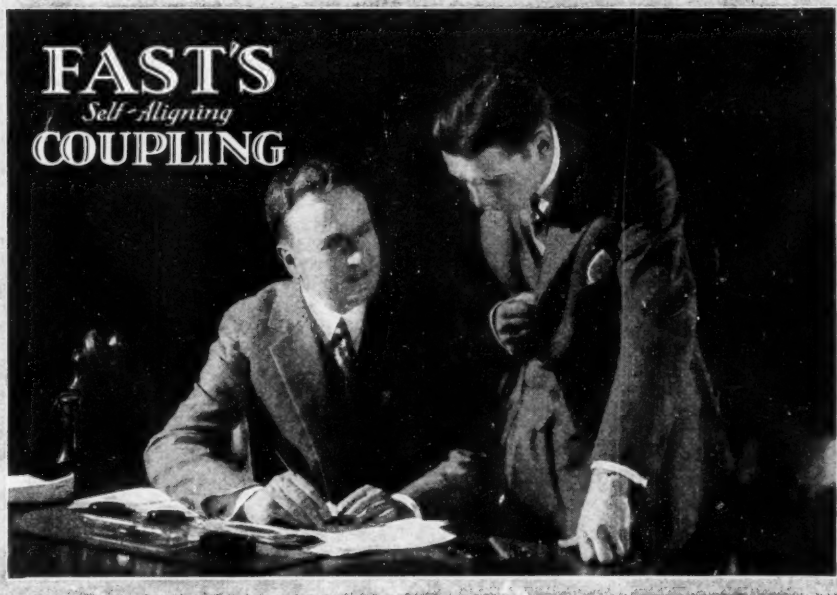
IT has long been known that severe worry or strain is sometimes accompanied by a sudden falling of patches of hair from the head. One of the most interesting cases of this type has recently been reported by Dr. R. B. Rogers of Neenah, Wisconsin. In the case mentioned, the father of three children had suddenly lost great patches of hair after the birth of each child in the family. Thus he had his first attack in 1915, his second in 1920 and his third in 1928.

Garage Deaths

THE United States is not the only country which is greatly concerned with the number of deaths that take place from automobile exhaust gas or from other chemical hazards in the motor industry. In Germany special attention has been given to this subject in recent years. Dr. O. Marienfeld finds that there were 242 deaths in garages in Prussia during 1926, most of them from carbon monoxide gas, but some of them from benzene or benzol poisoning and a few from electrocution while working on cars with electric wires.

With the usual German thoroughness, the author prepares an outline for the investigation of safety of working conditions in garages. The outline calls for inspection of the windows as to whether they are open or closed, ventilation, gas heating, electric wiring, temperature, the place where the body is found in relationship to the car, odors, smokiness of the atmosphere, and many similar factors.

FAST'S Self-Aligning COUPLING



Eliminate Your Coupling Shutdowns!

EVERY TIME an old-type flexible coupling fails—trace it and almost invariably it is due to the breaking down of flexible bushings, pins, springs, discs or grids.

No wonder "fatigue of materials" so frequently sets in wherever any material is under constant bending back and forth with each revolution of the shaft. Failure comes, and the drive must be shut down to replace the broken parts.

It Is Not Necessary!

Do you realize that 99% of flexible coupling troubles vanish when you replace flexible materials with the modern FAST'S Self-Aligning Coupling, which provides purely mechanical compensation for shaft misalignment?

See the sketch below. A spur gear on each shaft end. A casing, with internal gear teeth to match, slipped over the two gears. As one shaft turns, the casing turns also. The other shaft turns as a unit with it, the entire misalignment being taken up between the lubricated faces of the gear teeth.

Simple and Effective

Simple, isn't it? Instead of relying upon flexible pins, bushings, discs or springs to absorb misalignment, no flexible

materials are used. There is nothing to fatigue, nothing to be replaced, nothing that may cause a plant shut-down for repairs when you can least afford it.

Like most inventions that have revolutionized time-honored practice, Fast's coupling is so simple that in the ten years since its first development, it has swept the coupling field because of its remarkable performance.

Read Why

If you will mail the coupon, we will send you a bound reprint of the Prof. Moore article, "What Happens in Couplings," that tells the entire story. Learn how flexible materials can be eliminated, so your plant may eliminate flexible coupling failures.

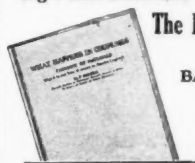
GET FREE BOOK

Sign and mail this coupon today to

The BARTLETT HAYWARD CO.

204 Scott Street
BALTIMORE, MARYLAND

Please send me the free book by Prof. Moore.



Name.....

Firm.....

Address.....

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aeronautics

THE PREDICTION OF AIRFOIL CHARACTERISTICS, Report No. 312, describes and develops methods by which the aerodynamic characteristics of an airfoil may be calculated with sufficient accuracy for use in airplane design. George J. Higgins is the author of the report. *National Advisory Committee for Aeronautics, Navy Building, Washington, D. C.—10 cents.*

SUGGESTED CITY OR COUNTY AERONAUTICS ORDINANCE AND UNIFORM FIELD RULES FOR AIRPORTS, prepared by the Aeronautics Branch of the Department of Commerce, outlines a standard code of airport field rules, supplementing existing Federal regulations for aircraft in flight, designed to save aviation from the confusing traffic codes now encountered in the automobile field. *Department of Commerce, Washington, D. C.—25 cents.*

Agriculture

INDUSTRIAL AND AGRICULTURAL USES OF JERUSALEM ARTICHOKE is an assemblage of the available facts about a tuberous artichoke from which laevulose sugar can be extracted commercially. Suited for widespread cultivation in Canada and the United States, this tuber may become an important factor in the sugar beet industry, according to the Canadian investigators. *National Resources Intelligence Service, Department of the Interior, Ottawa, Canada—Gratis.*

ELECTRIC STIMULATION OF PLANT GROWTH, by G. N. Collins, L. H. Flint, and J. W. McLane of the Bureau of Plant Industry in the Department of Agriculture, is the report of carefully conducted experiments which resulted in the conclusion that no significant change in the rate of growth can be attributed to electricity. The pamphlet is a reprint from *Journal of Agricultural Research*, Vol. 38, No. 11. *Government Printing Office, Washington, D. C.—25 cents.*

Industry

POPULAR RESEARCH NARRATIVES, THIRD SERIES, is the title of a volume containing 50 short stories of what science and research is accomplishing or has accomplished. The narratives are written in plain language, on an amazing variety of topics, each planned to acquaint the reader with the outstanding developments in a specialized field. *Williams and Wilkins Company, Publishers, Baltimore, Maryland.—One Dollar.*

DIESEL POWER PLANTS FOR LARGE CITY BUILDINGS, by Edgar J. Kates, is a reprint of an address given recently before the American Society of Mechanical Engineers in New York, which later appeared in *Oil Engine Power*. The paper is an analysis of the electric power requirements of large buildings, and a study of how they may be met by Diesel power plants, with figures on the economics of Diesel power in a municipal power plant, a large factory, and a typical New York office building. *American Society of Mechanical Engineers, 29 West 39th Street, New York.—Gratis.*

EXPLOSIVES SERVICE BULLETINS of the Du Pont company are issued frequently to assist users of explosives in various industrial applications. "A Few Suggestions for Producing Lump Coal," and "Placing the Detonator to Get the Best Results," are titles of two of the recent bulletins. *E. I. Du Pont de Nemours & Company, Wilmington, Delaware—Gratis.*

PERTINENT QUESTIONS AND ANSWERS (Bulletin No. 26) is a booklet containing much valuable information regarding respiratory protective equipment used by rescue crews and others engaged in activities requiring oxygen breathing apparatus and rescue equipment. *Mine Safety Appliances Company, Pittsburgh, Pennsylvania—Gratis.*

DUST EXPLOSION HAZARDS ENCOUNTERED BY FIREMEN IN FIGHTING FIRES IN INDUSTRIAL PLANTS, by David J. Price of the United States Department of Agriculture, is an interesting and helpful presentation of information concerning an important industrial problem. *Northwest Fire School, University of Minnesota, Minneapolis, Minnesota.—Gratis.*

AN X-RAY STUDY OF FIREBRICK, by Albert E. R. Westman, (Bulletin No. 193) is the report of an investigation to obtain powder diffraction patterns of a number of brands of commercial firebricks, to find what information could be obtained by X-ray examinations. *Engineering Experiment Station, University of Illinois, Urbana, Illinois—15 cents.*

BRITISH TRADE IN RUBBER AND RUBBER PRODUCTS, by Robert B. Bacattee, the American Consul at London, has been released as Trade Information Bulletin No. 644. The study covers recent developments in the British rubber industry, with a discussion of manufacturing trends in England. *United States Government Printing Office, Washington, D. C.—10 cents.*

OXWELDING ALUMINUM AND ITS ALLOYS describes in detail oxy-acetylene welding processes as applied to aluminum in all its forms. It includes complete instructions for welding both cast and sheet aluminum, and also the various aluminum alloys which have lately become of great importance in

manufacturing processes. *Linde Air Products Company, 30 East 42nd Street, New York City—Gratis.*

NICKEL CAST IRON: THEORY AND PRACTICE is a well-planned portrayal of the various attributes of this alloy. *International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

NICKEL ALLOY STEEL PRODUCTS is a buyer's guide, listing manufacturers of various items under such headings as "Axles, Auto" and "Forgings." The scope of the guide is limited to those items most frequently requested of manufacturers using nickel alloys. *The International Nickel Company, Incorporated, 67 Wall Street, New York City—Gratis.*

Minerals

MINERAL RESOURCES OF THE UNITED STATES IN 1928, by Frank J. Katz and Martha B. Clark of the Bureau of Mines, is a preliminary summary of the quantity and value of all mineral products of the country for the period covered. The arrangement is alphabetical by minerals, supplemented by tables giving the mineral production by states. Imports and exports are included in the summary, with figures from the records of the Bureau of Foreign and Domestic Commerce. *United States Government Printing Office, Washington, D. C.—20 cents.*

COPPER IN 1927, by C. E. Jilihn and Helena M. Meyer of the Bureau of Mines, contains complete data on copper production in the United States and Alaska during the calendar year 1927. The statistics cover also the imports and exports, by-products, consumption, and uses of copper during the period. *United States Government Printing Office, Washington, D. C.—10 cents.*

Railroads

THE RAILROADS ENTER AVIATION, by General W. W. Atterbury and Myron M. Stearns, is a reprint from the *Saturday Evening Post*. It is a candid portrayal of the reasoning of executives who have learned that the key to industrial and commercial development is in co-operating with new forces, rather than in opposing or seeking to ignore them. *Publicity Bureau, Pennsylvania Railroad, Broad Street Station, Philadelphia.—Gratis.*

103 YEARS OF RAILROADING is the story of the New York Central Lines, and is an interesting chapter in the commercial and industrial history of the United States. *Department of Publicity, New York Central Lines, New York Central Building, New York City.—Gratis.*

Miscellaneous

PIGOTT'S BULLETIN FOR EXPORT AND INTERCOASTAL SHIPPERS is a weekly index of advance sailings for all steamship lines operating from the United States and Canada to all foreign and intercoastal ports. It is considered the standard authority for such information, and as a guide for shippers, travelers, and operators. *Pigott's Publications, Inc., 80 Broad Street, New York City.*—Sample on application.

USE OF FILMS IN THE SCHOOLS, by Dr. Gustave Straubenmuller, is an analysis of the Eastman experiment with classroom films. Dr. Straubenmuller's study was made for the Board of Superintendents of the New York Board of Education, to appraise the value of classroom films in public schools. *Eastman Teaching Films, Inc., 343 State Street, Rochester, New York.*—*Gratis.*

REPORT ON PROGRESS IN MANCHURIA: 1907-1928 is a well-indexed 238-page volume covering the development and exploitation of a rich region that has been the scene of many conflicts and will probably be the scene of many more. *The South Manchuria Railway, Dairen, China.*—*Gratis.*

THE SPEAKER makes its debut as a monthly publication under the flag of Liberia. The initial number contains a treatise on the cultivation of the cacao tree, in addition to a number of brief essays and editorials. *D. B. Cooper, Editor, The Speaker, Cape Palmas, Liberia, West Africa.*—*Six cents a copy.*

STUDY OF THE OIL BURNER AS APPLIED TO DOMESTIC HEATING, TECHNICAL BULLETIN 109-T, presents comparative technical data derived from a series of tests with several types of burners to gage their performance, cost of operation, and adaptability for use in existing heating plants. It presents also a brief discussion of the relative costs of heating with oil and with gas. **THE DOMESTIC OIL BURNER, DEPARTMENT CIRCULAR 405-C** gives reliable non-technical information of interest to prospective purchasers. *Office of Information, Department of Agriculture, Washington, D. C.*—*Both gratis.*

REGULATIONS GOVERNING INTERNATIONAL CABLE AND RADIO MESSAGES, which became effective on October 1, are summarized for the benefit of code users. This summary, for the most part, is devoted to the types of languages which may be used, with specific regulations for the use of plain, code, and cipher languages. *The Merchants Association of New York, Woolworth Building, New York City.*—*10 cents.*

REFORMATION OF INTERFERENCE ISSUES, by Howard S. Miller, is a well-indexed booklet of 107 pages designed to help inventors and patent attorneys in prosecuting an application for patent when involved in interference proceedings. Particular attention is given to authoritative practice on setting for hearing motions under Rules 109 and 122. *Howard S. Miller, 1335 15th Street, N. W., Washington, D. C.*—*75 cents.*

3

Sizes of Motor Housings from a Single Die

THE skill and ingenuity of Milwaukee Die Casting technicians in the design and production of interchangeable dies enables the Dumore Company to secure die cast motor housings in three different lengths with but a single die cost.

As a result, they are able to produce fractional H. P. motors of different capacities with minimum labor and expense. Each of these housings is identical in diameter and in interior and exterior contour. The different housing lengths accommodate the different lengths of "fields" which produce the various fractional H. P. capacities.

Cover Also Cast In An Interchangeable Die

The die-cast cover for the motor housings is also made in an interchangeable die to permit the incorporation of several types of "bearing bosses" for different types of motors. Some have oil holes; others have machine threads. As in the casing proper, all holes are cast in, as are the field bore and bearing seats.

The "snap fit" necessary between cover and case is achieved entirely in the casting operation. No subsequent machining is required. The joint is a lap joint with a key cast in the cover and a keyway in the case.

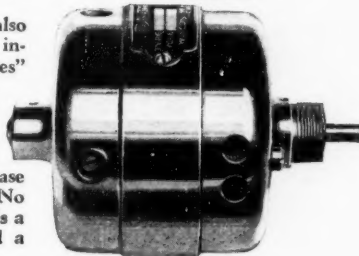
Modern developments in die casting practice may be the means of solving one of your difficult production problems. The counsel of Milwaukee Die Casting Engineers is available to you at no cost.

MILWAUKEE DIE CASTING CO.
287 Fourth Street Milwaukee, Wis.

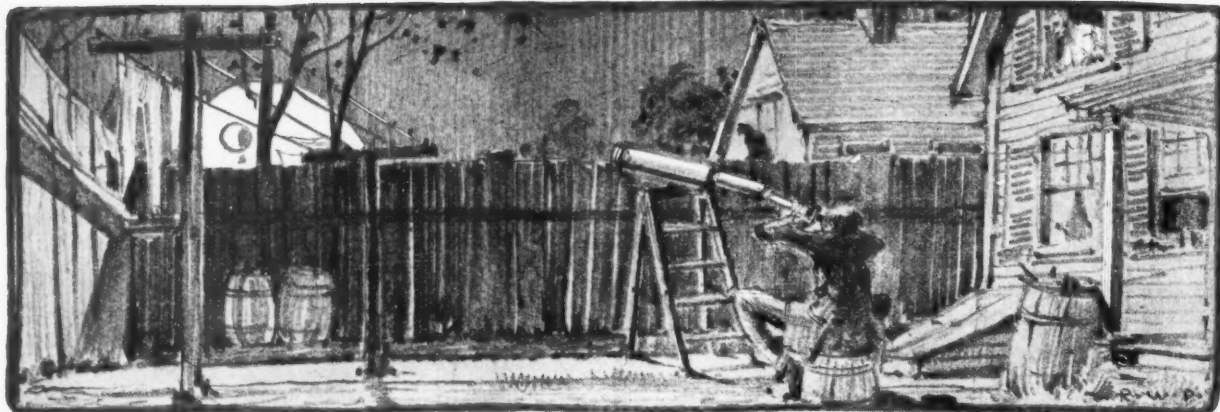
MILWAUKEE
DIE CASTINGS AND BEARINGS



The finish is an important factor in the appearance of Dumore Motors. These castings take a beautiful high lustrous finish in both nickel and chrome.



This simply written, well illustrated booklet will reveal to you the many possibilities of die casting parts of your product. Send for your copy today.



The Amateur Astronomer

THIS month we shall cut short the telescopes, satisfying our interest by a group of pictures which have self-explanatory legends. We shall then pass on to a most informative discussion of the principles of what the astronomer calls "good seeing."

In a recent number we published a letter from Ellison, co-author of "Amateur Telescope Making," in which the following statement was made: "The real difficulty about 16- and 21-inch jobs is in the mounting and using. I know from my experience with an 18 inch that observing with a 21 inch is no picnic."

The Reverend Mr. Ellison is, of course, referring to his own seeing conditions in the climate of Northern Ireland, and these conditions will differ from those in some parts of America, particularly in the west. Nevertheless, some of the considerations having to do with seeing and its principles, touched on below, are likely to prove of value. They may explain why it is all but futile in certain parts of our country to attempt to "manufacture" better seeing than can be had, simply by using large mirrors and crowding on higher magnification; also why it is that experienced observers keep pointing out that the practicability of larger sizes than ten inch, except for photographic work, is illusory in many cases.

Discussion by Mr. A. A. C. Elliot Merlin, under the heading "Fifty Years at the Telescope," in *English and Amateur Mechanics* (London) May 24 and June 7, 1929, quoted by kind permission of the publisher, bears directly on this point.

"A small instrument or five- or six-inch aperture is far more likely to reveal quickly its latent good qualities than one of eight or nine inches, for the reason that our earth's atmosphere is more frequently in a sufficiently tranquil state to allow the smaller apertures to attain their full defining limits on what must be classed as

to furnish sharp stellar images, whose spurious disks of 0.91" for a five inch and 0.76" for a six inch, will appear cleanly and steadily imaged on any tolerably favorable night; one which would quickly reveal its shortcomings with an instrument of perhaps only slightly larger aperture.

"The lack of appreciation of the most telling fact that air hindrance must necessarily increase as the square of the aperture, or ignorance of it, has led to misapprehension, chiefly directed against reflectors, for the reason that they have been, as a rule, of much larger aperture than the refractors with which their performance has been compared. The swamping of the defining quality of, say, an 18-inch aperture by what, to it, is a tempestuous atmospheric sea, is conspicuously observable; while an eight-inch aperture, reflector or refractor, placed alongside the big telescope, may be found to do sufficiently well in what is, to it, a moderate atmospheric disturbance.

"The obvious cause," Mr. Merlin continues, "is that the 18-inch instrument has an area of 254.5 square inches on the entire surface on which parallel light rays impinge, each of which has encountered equal air disturbance in its passage to the telescope, while the little eight inch has only 50.3 square inches of area, so can only collect on its surface five times fewer air-disturbed light rays; hence the atmospheric handicap at any one time is five times greater for the 18-inch telescope which, if used through no air at all, suppose on the airless moon, could only afford a defining power of a little over twice that of its small

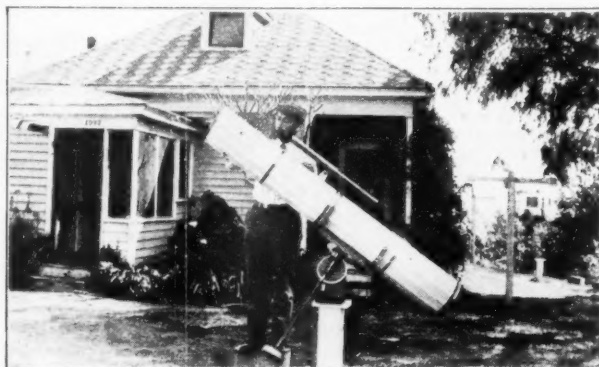


Photographed by Harold A. Lower, with an 8½ inch telescope. See "A. T. M.," p. 259

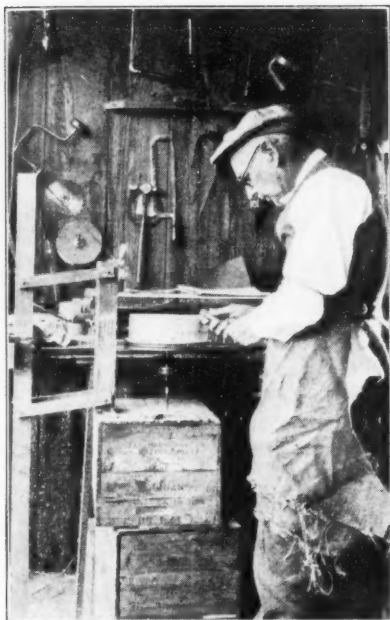
nights of exceptionally good seeing in this country. This is the secret of the popularity that the five-inch or six-inch refractor has long enjoyed. Telescopes of that size are large enough to afford sufficient light grasp when used with magnifications of 200 to 300 diameters, or even more, and at the same time encounter no excessive air hindrance, thus enabling them frequently



Harold A. Lower, 1032 Pennsylvania Avenue, San Diego, California, who with his father built a telescope



Mr. Lower with the completed telescope. The figuring was done on an H C F lap, which proved satisfactory



Mr. Lower inscribed this photograph: "Dad beveling the edge of the mirror disk. This is the rig we used for cutting out the disks"

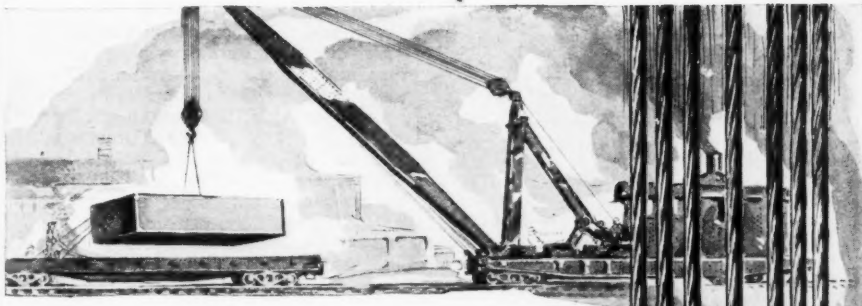
competitor, the eight-inch instrument."

In the last statement Mr. Merlin is referring to the fact that the resolving or defining power increases in direct proportion, not to the mirror's area, but only to its *diameter*. If we divide 4.56 seconds of arc by the diameter or aperture of our mirror or objective lens we get what is called the "Dawes Limit." (See Bell, "The Telescope," Chapter XI). For example, consider a six-inch mirror. Performing this simple feat of arithmetic we ascertain that this size ought theoretically to resolve or separate two stars not closer than 0.76" apart—although closer pairs can sometimes be seen elongated, their diffraction disks overlapping.

Separating a close double is essentially and optically the same thing as defining



The simple grinding rig. The lead weight applies added pressure. The picture also shows glass with disks cut out by rotary "cookie cutter"



Industry's Mainstay - and yours

Few realize how the individual, as well as industry, is dependent upon wire rope—the great flexible "handler" of practically everything.

The illustration shows a great slab of concrete bridge flooring being lifted onto a freight car.

All the material in a modern skyscraper is handled with wire rope—in the "raw"; in shipping; in the actual building erection.

Oil wells are drilled with wire rope; mines are mined and quarries quarried with it. Your furniture and the evening newspaper both originated in logs taken from the forests with wire rope.

Yellow Strand Wire Rope will usually be found where real stamina is demanded. Not mere strength, but strength so nicely balanced with elasticity, flexibility and resistance to the crystallizing effect of vibration, that long life under severest conditions is assured.

One *strand* of yellow distinguishes this high quality rope from all others.

Broderick & Bascom Rope Co.
St. Louis, Mo.

Eastern Office and Warehouse: 68 Washington Street, New York

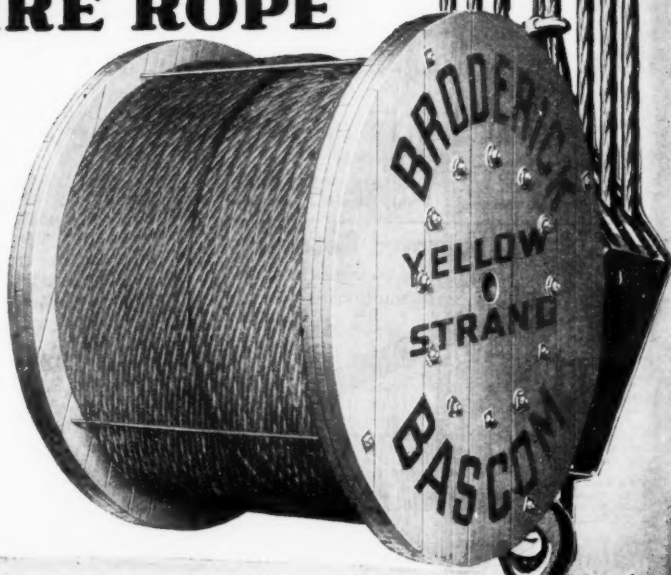
Western Offices:
Seattle and Portland, Ore.

Factories:
St. Louis and Seattle

Manufacturers of nothing but wire rope for over half a century.

Yellow Strand WIRE ROPE

Aerial Wire Rope Tramways designed by this company have features that insure economical operation.



N790R33

A NEW SMART GIFT FOR MEN



HERE'S a new kind of gift for a man. Called "the pencil with a brain." Multiplies — Divides — Solves difficult mathematical problems *instantly*—without setting pencil to paper. Just set the slides and read the answer—yet has all the features of any first-class mechanical pencil. Standard Model—(outside metal sterling silver - filled) \$5.00. Executive Model (14K gold-filled, in choice of colors) in handsome gift box \$10.00.

Order now.

RUXTON MULTI-VIDER CORPORATION,
Graybar Building, N. Y. City
RUXTON

MULTI-VIDER

PENCIL

RUXTON MULTI-VIDER CORP., Dept. 17A
Graybar Building, New York City

Please send me a Multi-Vider, with instructions for use. On arrival, I will pay the postman price quoted below plus a few cents postage. Within 5 days, if not satisfied, I may return the Multi-Vider and you are to return my money. I am checking the model I want. () Standard Model \$5.00. () Goldfilled Executive Model in a variety of colors, in handsome gift box \$10. Specify color for Executive Model—Blue, Green, Maroon, Black, Crimson and Black.

Name.....
Address.....
City..... State.....

BOILER FEED WATER TREATMENTS

of purity and all other required characteristics.

SIME, DARBY & CO.,
Singapore, S. S.
Agents for Straits Settlements.

UNISOL MFG. CO.,
Jersey City, N. J., U. S. A.

Improved Reception

from your present radio
is now made possible
by the—

RADIO CLARIFIER

\$3.00 Postage Prepaid

It clears the tone, decreases interference and increases volume. Overcomes fading of sound. Good for any wave length. Easily installed on inside or outside aerial. Simply cut wire near cabinet and connect between cabinet and aerial by using clips which are attached to Clarifier. Gives wonderful results. Satisfaction guaranteed. Worth many times its cost. Send \$3.00 for immediate delivery. Descriptive literature on request.

ROAT & LOHMAN, Dept. 404, Milton, Pennsylvania

minute detail on, say, the moon. Resolving power, and therefore *aperture*, is here the decisive factor. But, as we shall see later, there is a fly in the ointment: much of what we gain thus we lose in lack of contrast.

Professor A. E. Douglass, now Director of the Observatory at the University of Arizona but then on the staff of Lowell Observatory, published in *Popular Astronomy*, June, 1897, a long article entitled "Atmosphere, Telescope, and Observer," laying down certain basic principles which are equally valid in 1929 as in 1897, or any time. We shall quote salient parts of Prof. Douglass' article in a later number.

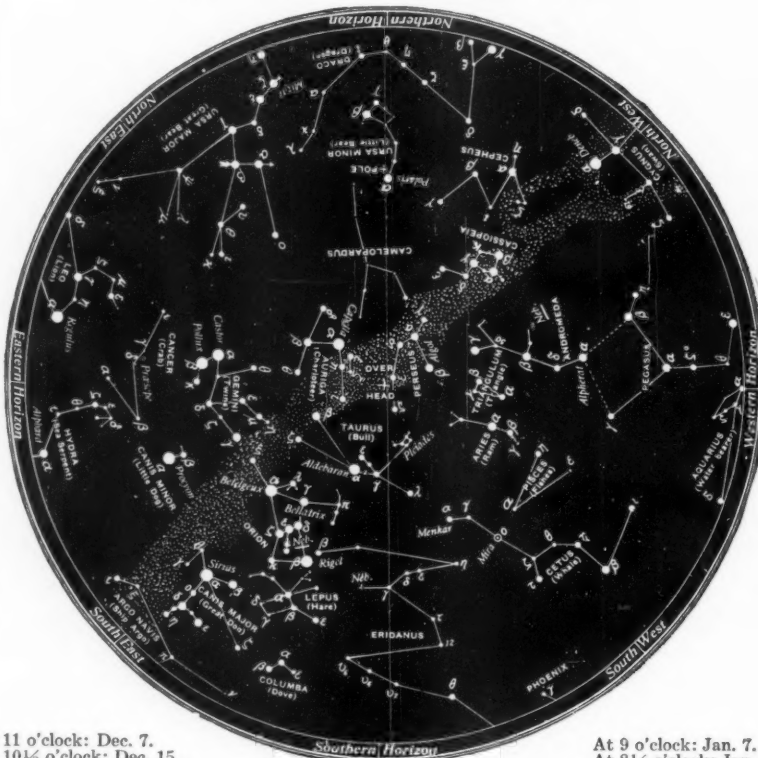
The *Journal of the Royal Astronomical Society of Canada* for October contains an interesting list of the reflecting and refracting telescopes of the world, compiled by W. E. Harper. In the list of reflectors

we find two instruments made from the instructions in the book "Amateur Telescope Making," one being that of G. H. Hamilton, of Jamaica, B. W. I., a 21 inch described in our issue of last May, and the other that made by Steber and Thurn, of Warren, Pa., described last June.

These two lists, as complete as the compiler could make them, show the world's telescopes above 15 inch distributed among sizes as follows: 100 to 50 inches, eight reflectors; 50 to 40 inches, five reflectors, two refractors; 40 to 30 inches, 24 reflectors, six refractors; 30 to 20 inches, 20 reflectors, 29 refractors; 20 to 15 inches, 15 reflectors, 56 refractors. No telescopes under 15 inches are listed—which lets out most of us who "roll our own." If what Mr. Merlin writes is correct, we amateurs are a wiser lot than we supposed.—A. G. I., Tel. Ed.

The Heavens in December

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Dec. 7.
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.

At 9½ o'clock: December 30.

At 9 o'clock: Jan. 7.
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan. 22.

NIGHT SKY: DECEMBER AND JANUARY

MERCURY is an evening star but is so far south in the sky that he will be hard to see. At the end of the month when conditions are best he sets at 6 P.M. Venus is still a morning star but is getting behind the sun. At the year's end she rises only 40 minutes before him and will no longer be easy to see. Mars is in conjunction with the sun on the 3rd and is unobservable. Jupiter is in opposition on the 3rd and is the brightest thing in sight except the moon, and is visible all night. His first and third satellites cross the disk on the evening of the first between 8 P.M. and midnight, while the second satellite is hidden behind the planet. This exhibition is repeated on the 8th between 11 P.M. and 2

A.M. Saturn is in conjunction with the sun on the 25th and can be seen only at the beginning of the month, just after dark. Uranus is in quadrature east of the sun on the 29th and is observable in the evening; while Neptune crosses the meridian between 3 and 5 A.M., so that the astronomer who would study it must rise early.

The moon is in her first quarter at 5 A.M. on the 9th; full at 7 A.M. on the 16th; in her last quarter at 9 P.M. on the 23rd; and new at 7 P.M. on the 30th. Her path in the heavens takes her near Mars and Mercury on the 1st, Saturn on the 2nd, Uranus on the 10th, Jupiter on the 15th, Neptune on the 21st, and Venus, Mars, and Saturn on the 30th.

The Scientific American Digest

(Continued from page 527)

culty. Because of the freight rates involved, however, a different type of fuel gas was used on each of the four legs of the voyage. It was decided that ethane would be the ideal gas to use as it is about the same weight as air and has a high fuel value. This gas was accordingly used on the first leg of the flight from Lakehurst to Friedrichshafen, having been shipped to Lakehurst in steel cylinders from a recently constructed ethane plant of the Union Carbide and Carbon Chemicals Corporation in West Virginia.

At Friedrichshafen the ship was refueled with Blau gas for the flight to Tokio.

At Tokio the ship was refueled with a mixture of Pyrofax and hydrogen. Pyrofax is commonly known to householders as a fuel for gas ranges in homes beyond gas mains. It was supplied in steel cylinders. Although it is somewhat heavier than air, a sufficient volume in the liquefied state could be much more cheaply transported from West Virginia to Tokio than could an equal volume of ethane. Therefore it was used, mixed with half of its volume of hydrogen, obtained in Tokio, to make the weight of the mixture approximately the same as that of air.

For the last leg of the flight from Los Angeles to Lakehurst, Pyrofax was shipped to Los Angeles where it was mixed with natural gas in suitable proportion. Shipment was made this time in tank cars, still further reducing the cost of transportation.

Thus the huge dirigible was supplied with suitable fuel gas at all points by means of an ingenious combination of various gases now commercially available in industrial centers throughout the world—a feat which would have been unthought of a decade or so ago.

Golf Ball Murders 74,000—Fish!

GOLF is charged with the murder of 74,000 fish at Glacier National Park fish hatchery. A player sliced badly, the ball entered and clogged the intake water line and the thousands of fish had no water in which to swim.—*Science Service.*

Burn Aluminum Dust for Intense Flame

A FLAME so intense as to melt its way through any known solid substance is produced by a new type of blowpipe, employing finely powdered aluminum instead of the more familiar hydrogen or acetylene gases. The new invention was described in Minneapolis recently by Dr. Frank M. Strong of Syracuse University, speaking before members of the American Chemical Society.

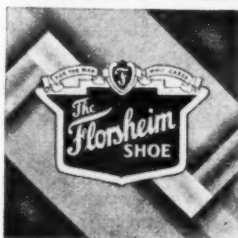
Dr. Strong described his device as follows:

"A screw conveyer carries a slow stream of aluminum dust from the bottom of a hopper out through the open end of a brass pipe. The dust is here met by a swift cross-stream of oxygen, with which it forms a fine and uniform suspension. From this point the mixture is passed forward through a larger tube, which a little farther along is divided up into eight smaller tubes. The latter diverge from the central tube for a short distance, and are then curved back inward so as to come to a sharp focus. The aluminum-oxygen flame can be lighted at this focus

for the Man
who Cares



The FLORSHEIM Shoe



RELY on FLORSHEIM SHOES for service... their many years of dependable performance is a criterion of quality... they have always made good... and they will today

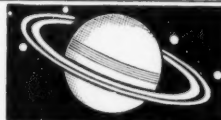
Most Styles \$10

THE STRIDE... Style M-376

THE FLORSHEIM SHOE COMPANY
Manufacturers · Chicago

WANTED —an opportunity to back engineers with new ideas for the improvement of airplanes. If we feel your inventions are practical we will help you develop them.

ALEXANDER AIRCRAFT CO., Dept 8, Colorado Springs, Colo.



ASTRONOMICAL
TELESCOPES

Send for Catalog
WM. MOGEY & SONS,
Inc.
PLAINFIELD, N. J.

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.

PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

TOWER BUILDING
Chicago, Ill.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

FREE 25 Edwin Jr. PANATELAS
With Your First Order for
50 Edwin's OLD TIME \$2.19
STRAIGHTS
15¢ Quality Guaranteed

75 CIGARS AT LESS THAN 3¢ A PIECE

Made of genuine imported Picadura, from our own plantations. Same quality tobacco as used in 15¢ Cigars.

HOW WE CAN AFFORD IT
We do not spend a cent for bands, decorated labels or fancy boxes. We do not risk a cent on credit. We save money by mass production. We buy large quantities of the finest tobacco direct from the grower in Cuba, for spot cash.

FREE TO DEC. 31st

Until Dec. 31, we will give readers of this publication, with their first order **25 JUNIOR PANATELAS FREE**

YOUR MONEY BACK

—if you don't get three times the value in supreme smoking pleasure. Smoke as many of these cigars as you like—all if you wish and if you are dissatisfied we'll **REFUND YOUR MONEY IN FULL**

I have been making cigars for over fifty years. My company has been established since 1903. Reference: National City Bank, New York, or any bank in Cuba.

JUST ONE STIPULATION

We reserve the right to return your money after the limited quantity of Junior Panateles available has been distributed. Send in your order today with check or pay postman. We pay the delivery charges.

DIV. Y EDWIN CIGAR CO.
2338-40 THIRD AVE. - NEW YORK

Christmas Gift

Strange Tales from the Frontiers of Science

Science News-Letter is a weekly enjoyed by the general reader who thrills to the new and unusual. It has a specific appeal to those with a scientific leaning.

Science News-Letter brings news from Nature's great outdoors . . . insects . . . wild flowers . . . beasts and birds of the field and forest . . . fish and creatures of the sea.

Ancient civilizations are made to live again by the spade of the archaeologist . . . adventures in strange lands . . . explorations . . . provide romantic stories in Science News-Letter.

When astronomers probe new universes . . . or amateurs chase meteors . . . when chemists and physicists discover elements in the making . . . you can star-gaze, guided by maps in this weekly.

Science News-Letter makes a fine and an intelligent Christmas Gift.

SCIENCE NEWS-LETTER

Gift card covering year's subscription \$5.00.

Introductory offer \$1 for 13 weeks \$2 for 6 months

2121 B Street, Washington, D. C.

point with a match or Bunsen burner."

Dr. Strong's blowpipe combines the principles of the familiar oxy-hydrogen or oxy-acetylene blowpipes with that of thermite, a powder used for the generation of intense heat on a limited area, such as the ends of rails in welding. Thermite consists of aluminum powder mixed with another chemical which on heating yields free oxygen at a rapid rate. In the new blowpipe the oxygen is supplied directly in the form of a gas instead of being generated on the spot from a chemical. —Science Service.

Cave Man's Brain Found in Russia

A RARE find of human brains, representing our ancestors thousands of years ago, has been announced from Odinzowo, near Moscow, in central Russia. The two petrified brains were found associated with the teeth of a woolly mammoth, and they were without doubt the very oldest fossilized human brains ever found.

It is reported that a commission of scientists has been selected to make detailed studies of these remarkable finds of man during the ice age when the huge mammoths and the rhinoceros were clothed with a thick coat of woolly hair.

These rare finds are not "casts," but actually petrified human brains, somewhat shrunken, to be sure, but sufficiently well preserved so that anatomists can reconstruct the form of the brains from the fossils.

The cave man was equipped with a goodly supply of gray matter. The Russian scientist, Hindze, who is preparing a report on the fossil brains, is of the opinion that man in the ice age possessed a brain slightly smaller and less developed than recent dwellers of the same area. —Science Service.


Prehistoric Indian Dentists Filled Teeth

MAYAN Indians who lived in Central America more than 1000 years ago practiced dentistry and knew something about the technique of drilling holes in teeth and filling up the cavity with metal. Two teeth containing circular holes filled with iron pyrites are among the significant discoveries reported by J. Eric Thompson, leader of the Captain Marshall Field Archeological Expedition to British Honduras, which has just returned to the Field Museum of Natural History.

The teeth were found in a vaulted burial chamber in the ruins of the Mayan city of Tzimin Cax, which means "Mountain Cow." A good collection of Mayan painted pottery was found in the chamber. Other burial chambers yielded skeletons and pottery types hitherto unknown in the Mayan art, also jade ear-plugs and apple-green jade beads.

While digging in a large mound in the ruins of the city, the expedition made the first authenticated find of a mirror from a site of the Old Empire of the Mayan tribes, that is, from the period between 400 and 800 A.D., Mr. Thompson states. The object consisted of a number of small squares of iron pyrites, which apparently had made a shiny metal looking-glass with a pottery back. Heretofore, it has been generally supposed that the inhabitants of the early Mayan cities were unacquainted with the use of mirrors. —Science Service.

UNIQUE THIN LEAD
TRADE MARK
COLORED PENCILS
24 Colors
Make fine lines in color



UNIQUE pencils have even more uses than they have colors. They appeal to everybody who wants to do neat fine work in color . . . such as checking, sketching, underscoring, map coloring, correcting blueprints, proof reading, etc.

UNIQUE leads are as thin as those of a No. 2 VENUS black writing pencil. They can be sharpened to a needle point.

12 Colors (Asst. No. 1116) per box \$1.00
24 Colors (Asst. No. 1117) " \$2.00

At all dealers or write direct
American Pencil Co., 542 Venus Bldg., Hoboken, N. J.

A VENUS Pencil Factory Product

WANTED MEN

To Manufacture Metal Toys and Novelties

Big demand for Toy Soldiers, Animals, 5 and 10c Store Novelties, Ashtrays, etc. We co-operate in selling goods you make also buy them from you. Small investment needed to start and we help you build up. WE FURNISH COMPLETE OUTFITS and start you in well paying business. Absolutely NO EXPERIENCE and no special place needed. A chance of a life time for man with small capital. CHRISTMAS BUSINESS is now starting, so if you mean strictly business write AT ONCE for full information.

METAL CAST PRODUCTS COMPANY
Dept. S 1696 Boston Road New York City



The Midget "Five-in-One" Slide Rule

is a combination Mannheim, Poly-metric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Log, Sine and Tangent. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adapted by colleges. Price with instructions, \$1.50. Fabricated Case, 50c extra. Sent C. O. D. if desired. Catalogue Free. **WILSON SLIDE RULE CO., Stuart, Florida**



CHEMISTS

Catalog illustrating 2500 Chemist's Supplies, 5000 Chemicals, Minerals, Drugs, etc., and listing 1000 Scientific Books sent for 50c. Glass Still, as illus. cap. of flask 1 Qt. complete \$8.

LABORATORY MATERIALS CO.
637 East 71st Street, Chicago.



AGENTS 500% PROFIT

GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

ASBESTOS

All grades of Crudes and Fibres in large or small quantities

Sold by

KEASBEY & MATTISON COMPANY

Ambler, - Penna.

Branches in Principal Cities

Chemistry in Industry

(Continued from page 534)

at 20 degrees, Centigrade, proved harmful to tench, which are noted for their tenacity of life, after a period of three hours and five minutes. The tench were then removed to fresh water and died three days later. However, a one-tenth of one percent solution of calcium chloride had but slight effect upon trout and tench when the temperature of the water was six degrees, Centigrade.

Numerous investigators have shown that many fresh-water fish will die if subjected to the action of water of high salinity; the ill effects are largely attributed to the unbalancing action of water of greater specific gravity, a diminution of some of the essential food, and also, tendency toward loss of water from the body of a fresh-water fish when placed in a salt solution; this latter phenomenon is explained by the theory of osmosis. Bass transferred from fresh water directly into sea water died in a few minutes. However, a transfer of bass and perch from fresh water to a sodium chloride solution containing approximately 14,000 parts per million failed to produce any fatalities in 14 days.

Those interested in further details as to the effect of impurities in streams on native fish will find a vast fund of information available at the United States Bureau of Fisheries, Washington, D. C.

Novel Method for Making Citric Acid

CITRIC ACID from lemon juice and similar raw materials without the intermediate production of citrate of lime, has been worked out by Professor Dr. C. Crotto of the School of Pharmacy in Buenos Aires, says a recent issue of "*Quimica e Industria*." The elimination of the usual step of neutralizing the acid of lemon juice with lime to form calcium acetate is expensive and the yield poor, so that this novel process promises appreciable savings.

In outline the process is as follows: The lemon juice is concentrated in vacuo to the consistency of a semi-solid and is then macerated with acetone, the weight of acetone used being double that of the concentrated juice. The albuminous, pectic, mucilaginous, and other insoluble substances are separated by filtration and the filtrate treated with half of its weight of distilled water. The citric acid dissolves in the water and the acetone is separated and recovered. The process is patented and is stated to give perfectly satisfactory results on a semi-large scale.

Rust Used in New Base for Paint

RUSTY tanks for oil storage or other exposed iron surfaces require cleaning as a preparatory to receiving a protective coat of paint; this is a laborious and consequently costly process. A recently patented means to preserve the metal consists of applying a mixture which penetrates the rust layer, forms a base for paint of which the rust is a part, and prevents further corrosion.

The material is said to have the additional advantage of resisting the solvent action of gasoline and other mineral or fatty oils. First an emulsion is made with linseed oil and alkali. Second, casein and silicate of soda are made into a smooth, viscous mass and mixed with the oil emul-

MAKE MACHINES IN THE SHOP

REPORT AT YOUR DESK



by wire to **Veeder-ROOT**
MAGNETIC COUNTERS

How much from those new "automatics" NOW? Get the answer up-to-the-minute by glancing up from your desk. There on the dials of Magnetic Counters, read the production of any machines in the shop. Be in complete control of your schedules through this continuous check-up of each machine.

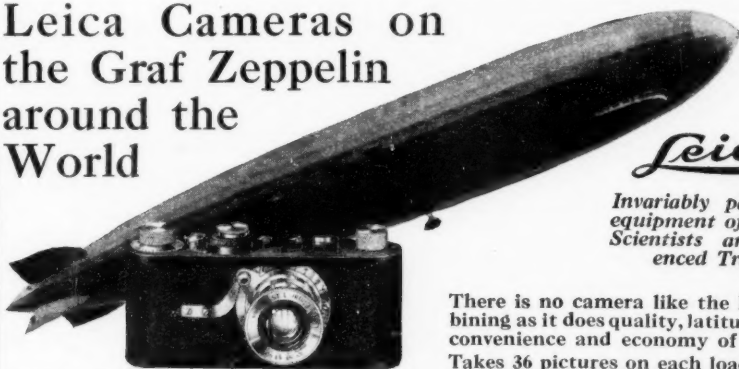
Mechanical contacts on machines make and break the electrical circuits which operate the counters over your desk, or "banked" conveniently on a Counter-Board. The electro-magnetic drive of the counter gets its current from your regular lighting circuit: Alternating current either 55, 110 or 220 Volts as ordered. Also furnished for operation by direct current or storage battery.

Write for new Catalogue with the data complete.

Veeder-ROOT INCORPORATED
HARTFORD, CONN.

Offices in the Principal Cities; write or phone.

Leica Cameras on the Graf Zeppelin around the World



Leica

Invariably part of the equipment of Explorers, Scientists and Experienced Travelers

ON the Graf Zeppelin's west bound trip one of the several Leica Cameras on board was used to photograph the interior of the torn bag. Motion prevented time exposures—the only light was that reflected from the ocean through the ripped opening, yet the pictures were remarkably clear.

Several Leicas accompanied the Byrd Antarctic Expedition. Six more have been ordered by radio since the intrepid men reached their winter base.

The Leica is known and used throughout the world by scientists, engineers and those who follow the advancement of photography.

There is no camera like the Leica combining as it does quality, latitude of work, convenience and economy of operation. Takes 36 pictures on each loading. Uses standard cinema film and each negative is of double framesize—the first camera to have this feature. The smallest roll-film camera with focal plane shutter.

May be used for snapshots, portraits, indoors or outside. Used by engineers for recording data and by scientists for photo-micrographs. Always ready for instant use.

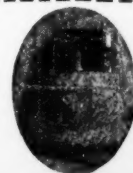
Leica enlargements to 12" x 18" or larger, preserve beauty and detail. Mechanically and optically the Leica is a model of perfection.

See the Leica at your dealer's. He will gladly demonstrate it for you. Or write for illustrated literature. E. Leitz, Inc., 60 East 10th St., New York, N. Y.

E. LEITZ, Inc., Dept. S. A. 5, 60 East 10th St., New York, N. Y.
Please send me catalog on the Leica Camera.

Name

Address



Fits
Vest
Pocket
or Purse

DEAFNESS

The "PHONAK"

*A new scientific
hearing aid
now available*

Clarity and purity of tone
Quietness of Operation
Adequate Volume and Range

No Crackling
or Hissing Sounds
from the
Electrical Currents

FRENCH ELECTRIC CO., Inc.
654 Madison Avenue
New York

GEORGE BARTON FRENCH
PRESIDENT

Circular on Request

Magnified 225 Diameters This is what the tip of a fly's leg looks like when seen through the ULTRALENS MICROSCOPE



At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send \$5.00 for complete outfit. Send for descriptive literature.

\$5.00
for Complete
Outfit Prepaid

ROAT & LOHMAN
Dept. 102 Milton, Pa.

Eladis' SPORT GLASS VEST POCKET



**Get the Habit—Carry Them Always
in your pocket!**

Compact—have them with you at football games, races, ringside and outdoors. Different, powerful with wide field of view (265 yds., at 1000 yds.); 90% luminosity. Beautifully finished. Every one would be delighted to own an "ELDIS" 3 1/2 inches long; 1 3/8 inches high; 1 3/16 inches wide. Weighs 4 oz. Soft leather pouch. Blue, fawn or tan finish \$13.50; Black \$13.

Ask Your Dealer—sent direct if he cannot supply. Money back guarantee.
Write for folder "M".
Dealer's inquiries invited.

AMERICAN THERMO-WARE CO., Inc.
Exclusive Importers—Est. 1901
16 Warren Street
New York

sion. Whiting and zinc oxide are stirred in, and colored pigments may be added if desired; a preservative such as phenol or salicylic acid may be added in small amount if the mixture is to be stored before use. It works best on rusty surfaces to which it adheres firmly, and when dry makes an economical base for paint. The process is covered by United States patent 1,647,666.

Processes Developed to Bind Fixed Nitrogen

AN interesting series of processes utilizing phosphate rock to bind fixed nitrogen has recently been introduced into this country by the Dorr Company, Inc. The processes were developed by Frans G. Liljenroth, a prominent Swedish engineer whose name has been associated with some of the pioneer work in developing phosphoric acid technology.

Kunstdunger Patent Verwertungs A. G., of Switzerland, has been formed as a patent holding corporation and will continue research work in connection with nitrogen binding and the production of concentrated synthetic fertilizers.

The Dorr-Liljenroth processes bind from 20 percent to 70 percent of the nitrogen in the form of concentrated mixed fertilizers containing from 40 to 70 percent total plant food and the remainder as ammonium sulfate and calcium nitrate containing from 14 to 21 percent nitrogen.

It is claimed that the over-all binding cost of a plant with a capacity of from 20,000 to 25,000 tons of ammonia per year will be from 0.6 to 1.2 cents per pound, depending on the type of materials produced.

Regulating Thickness of Electro-Plating

ELECTROPLATERS are already making use of instruments for measurement and control of temperature, pressure, and acidity in electrolytic baths. But another necessity is to control the thickness of the deposit by suitable regulation of the current density. To meet this need, the LPW current density meter has been developed abroad and is described by W. Pfanhouser in *Chemiker-Zeitung*. It consists of two round comparator electrodes in a hard rubber housing, insulated from each other and connected together across a small meter. The instrument must be calibrated according to the solution in which it is to be used and must be placed in proper position with respect to the anode and cathode. It serves to show the time required for a given thickness, and also helps maintain quality by keeping the current density within proper limits.

Ferric Chloride Becomes Cheap Coagulant

STRICTLY speaking, ferric chloride in solution is not a new coagulant, but for many industrial purposes its price has prohibited its use. Recently, however, ferric chloride has appeared on the market in commercial quantities at prices which make it economical for use in sewage disposal systems and for other coagulating functions. Industrial and Engineering Chemistry comments on this significant development as follows:

"It frequently happens that the adoption of a material for a particular large-scale

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - Chicago, Ill.
HOBART BUILDING - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.

Books and Information on Patents
and Trade-Marks by Request

Associates in All Foreign Countries

INVENTORS' MODELS

Mechanical
Specialists for over
20 years. Rendering
Complete Service to
the man with an idea.



Labor Saving
Machinery
Designed • Built

Circulars - References - Guarantee - Free
BERNARD & HELLER - 31 East 17th St. N.Y.C.

I SELL PATENTS

If you wish to add New Products to your line,
or have a good Patent to sell, write me—

CHARLES A. SCOTT

Established 1900
773 SA Garson Ave. Rochester, N. Y.



Inventors--We Build Models

Send us your rough idea. Our Master Mechanics will develop it for you into a practical working Model. Thirty years successful experience doing this very thing. Best shop equipment. Expert advice. Confidential service guaranteed. Bank reference furnished. Send for free booklet "The Road To Success."

CRESCENT TOOL CO., Dept. C. Cincinnati, Ohio

Experimental and Model Work

Fine Instruments and Fine Machinery

Inventions Developed

Special Tools, Dies, Gear Cutting, Etc.

HENRY ZUHR, Inc. 187 Lafayette St., New York City

WANTED

For manufacturing and selling by a prominent, long established Massachusetts concern, special or patented equipment for Water Storage Reservoirs, Filtration Plants, Irrigation Development. Liberal royalties on exclusive manufacturing basis. Address BOX 193, SCIENTIFIC AMERICAN, New York City.

WANTED PATENTED SPECIALTIES

Desire articles which can be stamped from sheet metal and pertaining to automotive, radio, or hardware lines. If attractive to us will either buy outright or make satisfactory royalty arrangement. Send full information and drawing. Over forty years in business.

THE OTTO KONIGSLOW MFG. CO.
3500 Perkins Ave. Cleveland, Ohio.

HAVE YOU AN ELECTRICAL PROBLEM?

WE SPECIALIZE IN "PERSONAL SERVICE", and solve them for YOU through the mail with Precision. Write us now. TAHSESAEB, P. O. No. 132, FLUSHING, NEW YORK

MONEY

MYSTERY GAS LIGHTER

JUST OUT, LIGHTS GAS INSTANTLY WITHOUT SPARKS OR FLAME - SELLS LIKE WILDFIRE WHEREVER GAS IS USED - RETALS FOR 25¢

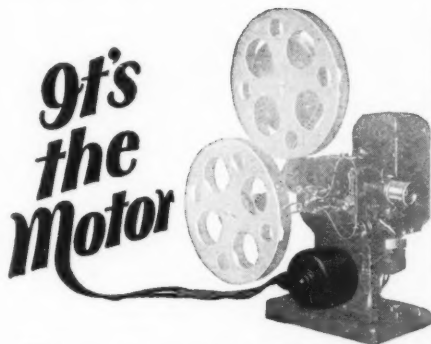
MAKE \$25. A DAY

PACKED ON INDIVIDUAL CARDS WITH INSTRUCTIONS

RUSH \$10.00 FOR GROSS - 1st FOR 10¢.

NEW METHOD MFG. CO.
Desk SA-12 Bradford, Pa.

MONEY



Whatever the projector flashes on the screen... your vacation trip... your hunting trip... your little tots... remember it's the motor that furnishes the action... that is the heart of the projector. And, in this projector (reproduced above) it's a Signal Fractional Horsepower Motor—selected because the motor will render dependable service with low consumption of current. No better motor could be put into such a device... another use for small motors. Signal Fractional Horsepower Motors—either induction or series wound—are designed from experience to meet manufacturers' needs for hundreds of different appliances. Perhaps our experience can help you, too.

SIGNAL ELECTRIC MFG. CO.
Menominee, Michigan
Small Motor Specialists Since 1890

SIGNAL
MANUFACTURERS OF ELECTRICAL PRODUCTS



BECOME A FOOT CORRECTIONIST

\$3,000 to \$10,000 yearly in a business of your own—many are making it in the New Profession of foot correction; not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.

STEPHENSON LABORATORY
23 Back Bay Boston, Mass.



THOUSANDS OF MEN

will make fortunes in Aviation. Airplane Drafting and Designing are the biggest jobs ahead in this fastest growing industry. A new field of opportunity for you is opened in our improved method of training.

EASY TO LEARN. STUDY AT HOME. PAY AS YOU GO. EMPLOYMENT SERVICE.

Write for booklet outlining courses in Airplane Drafting and other aviation subjects, including the famous Weem's System of Navigation—endorsed by Col. Lindbergh, Commander Byrd, Lincoln Ellsworth, Admiral Moffett, etc.

Name.....

Address.....

City..... State.....

☐ AIRPLANE DRAFTING
☐ AIRPLANE MOTORS ☐ AIRPLANE MECHANICS

PACIFIC TECHNICAL UNIVERSITY SAN DIEGO CALIFORNIA

use leads to its manufacture in such quantities as to bring the price within the reach of others long interested but not able to buy. It is in this connection that we note with interest a contract recently awarded the Pennsylvania Salt Manufacturing Company by the Sewerage Commission of the City of Milwaukee, calling for between 2000 and 2500 tons per year of ferric chloride in solution at a price of \$2.08 per hundred pounds on the anhydrous basis, delivered at the sewage plant.

"The solution will be transported in rubber-lined tank cars and will replace chlorinated copperas heretofore used. The availability of ferric chloride in solution in quantities that will greatly reduce its price would seem to open up a number of possible applications and make it a direct competitor with the older coagulants.

Lignite Absorbs Sulfur Gases

AN interesting process for sulfur removal from gas is reported by Dr. F. Neuwirth, a German chemist. In the research laboratory of the Oesterrichischen Montangesellschaft it was found that a local ligneous coal, steam-dried, had a great absorptive affinity for various gases and behaved much like activated carbon. Slow passage of a coal gas over this dried lignite resulted in the removal of 80 to 90 percent of the hydrogen sulfide, and simple treatment with superheated steam regenerated the coal for fresh use again. Similar trials with the coke from this coal, activated at 800 degrees, Centigrade, with CO₂ showed an even more active absorption.

Finally, similar trials with the raw ligneous coal gave the surprising result that it has by far the most favorable action, especially at a raised temperature of preferably 70 to 80 degrees, Centigrade, and that it could be regenerated by mere wetting with water. Quantitative tests after a 15th regeneration still showed a removal of 98 percent, 600 grains of coal absorbing 77.8 grains of sulfur. Sulfur dioxide was removable in the same way, in fact the process has suggested itself strongly for American use for various cracking gases and the like since it is quite probable that some native lignites possess the same strange property.

New Material for Crucibles Outpoints Porcelain

A NEW fireproof product intended to take the place of porcelain has been placed on the market, the product of a Holland manufacturer. Weta-material consists of very fine, uniformly distributed carborundum particles with admixed silicates and metals of the iron series, cobalt and nickel, and sinters, after firing in a porcelain kiln, at about 1400 degrees, Centigrade. A pot is obtainable which, without any glazing, is completely watertight. A glowing hot Weta-material crucible can be chilled in cold water without injury. The dark gray crucible can be used for qualitative and quantitative analyses and on account of its resistance to breakage is especially adapted for work under very high pressures. Weta dishes survive a large number of determinations without cracking due to decided changes of temperature, knocks, or blows. Tubes can also be produced from Weta-material for use in the manufacturing plant. Weta-material ranks somewhat better than porcelain crucibles from the state porcelain factory.

Will you invest \$100 for 12 of the finest cigars that skill and experience can produce



Two cigars each of all six sizes that we sell regularly for \$8.00 to \$20.00 per 100.

We want you to become familiar with the complete line of the Famous Bouquet de Rose Cigars.

Every cigar is made by hand in our own factory, filled with the finest Havana tobacco grown. Our representative in Cuba procures the choice leaves from the richest crop Cuba produces. You cannot duplicate these cigars anywhere else for half again as much money.

If you don't find them as represented, your money will be refunded in full.

We can afford to send only one sample box to a customer, at this special price. Coupon below must be used.

MARVIN CIGAR CO.
364-376 CANAL PLACE, NEW YORK

Enclosed find \$1.00 for which send me prepaid one Sample box of 12 Bouquet de Rose Cigars containing 2 cigars each of all six sizes that you sell regularly from \$8.00 to \$20.00 per 100.

☐ Mild ☐ Medium ☐ Strong

Name.....

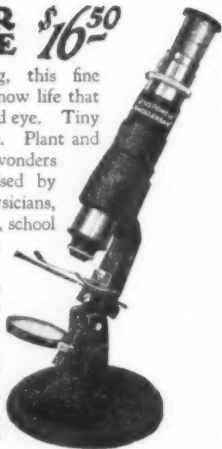
Address.....

City..... State..... 17

CHICAGO TECH
FOUNDED 1903
ENGINEERING-ELECTRICITY ARCHITECTURE-DRAFTING
4 Fields of real opportunity. Big pay—a permanent position or a business of your own. 7 Billion dollars spent last year in one of these fields alone. Train here in Chicago, America's industrial center. 1, 2 and 3 year courses. Diplomas and B. S. Degrees. Special 4 months' practical course in Drafting. Other short courses. Earn while you learn. Enter any time. Day and evening classes. No time wasted. Free Employment Bureau. Low tuition—easy terms. Athletics. Successful graduates everywhere. Free 80-page "Blue Book." Address the President, Chicago Technical College, Dept. R-57, 118 E. 26th St., Chicago, Ill.

250 POWER MICROSCOPE \$16.50

MADE IN U.S.A.
Educational, entertaining, this fine microscope helps all to know life that can't be seen with unaided eye. Tiny insects look like monsters. Plant and mineral life reveal new wonders in form and color. Used by students, dentists, physicians, scientists—in home, office, school and laboratory. Precise optical qualities. Magnifies 100 to 250 times. Tilting stand, fine finish, nickel trim, plush-lined case, prepared slide, instructions. At your dealer or direct postpaid. Money back guarantee. Other models \$2.50 to \$8.50. Catalog Free



Wollensak Optical Company

914 Hudson Ave. Rochester, N. Y.

25 POWER \$1 GERMAN POCKET MICROSCOPE

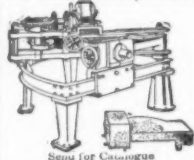
A marvelous German 25 power microscope, size of pencil. Enlarges diameter 25 times, area 625 times. Fine lenses give extra large field and great light. Only 4 1/2 inches x 5 1/4 inch; weighs but one half ounce. Used in schools and colleges throughout the country. Fine for biology, geology, botany, nature study, examining stamps, insect prints, insects, cloth, metals, photographs and thousands of other things. Equipped with handy fountain pen clip. 40-50-60X, 1 1/2 oz. \$4. \$1 prepaid. Money back guarantee. Discount for 6 or more.

BINOCULARS Over 200 Glasses All Makes \$1-\$110

Everything in binoculars, field glasses, telescopes and optical instruments. The finest and largest assortment in America. Catalog gives all information how to choose the best for your individual needs at the LOWEST PRICE.

Try America's Leading Binocular House First DuMaurier Co., Dept. 1612 Elmira, N. Y.

"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe



Hand and Motor Operated

14 Sizes of Machines
What it costs to bend pipe our way, per foot:
1-inch pipe 5 cts
2-inch pipe 10 cts
4-inch pipe 25 cts
6-inch pipe 40 cts
8-inch pipe \$1.00

American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.

GEARS

In Stock—Immediate Delivery
Gears, speed reducers, sprockets, thrust bearings, flexible couplings, pulleys, etc. A complete line is carried in our Chicago stock. Can also quote on special orders of any kind. Send us your blue prints and inquiries.

Write for Catalog No. 79
CHICAGO GEAR WORKS
769-763 W. Jackson Blvd., CHICAGO, Ill.

SPRINGFIELD RIFLE, Model 1903

\$19.50

Assembled and Refinished
\$34 pounds, 43 inches long, 24 inch barrel. Offered without bayonet, \$19.50. Packing charge 50c extra. Ball cartridges \$3.50 per 100. New catalog, illustrated, 380 pages of Army-Navy equipment, pistols, guns, uniforms, saddles, for 50 cents. Special new circular for 2c stamp. Established 1865. Francis Bannerman Sons, 501 B'way, N. Y. City

RADIO FREE CATALOG

AT WHOLESALE PRICES
166 pages of radio bargains. New Screen Grid, all-electric, A. C. Sets in beautiful consoles—also battery operated sets as low as \$15.95. Write today.
ALLIED RADIO CORPORATION
711 W. LAKE ST., DEPT. 57 CHICAGO

TYPEWRITER 1/2 Price

World's best makes—Underwood, Remington, Royal—also portable—prices smashed to below half (50¢ down).
SEND NO MONEY
All late models completely rebuilt and refinished brand new. Guaranteed for ten years. Send no money—big free catalog shows actual machines in full colors. Get our direct-to-you easy payment plan and 10 day free trial offer. Amazing values—send at once.
231 W. Monroe St. Free Trial
International Typewriter Exch., Dept. 1260 Chicago



Learning to Use Our Wings

(Continued from page 529)

At the conclusion of the solo demonstration as slow a landing as the conditions permit is made and the plane is taxied smoothly over the ground. During the demonstration the salesman on the ground is carrying on his talk in tune with the demonstration. Immediately after an inspection of the plane, each of the prospects is sent up for a short smooth ride, during which an attempt is made to impress him with the steadiness and safety of the plane.

The newspapers are very fond of talking of airplane sales to the average American family, but the average American family is not yet in the market. The American Aircraft Corporation lists its best sales sources in the following order: the dealer, the flying student, the successful business man, and the wealthy sportsman. It might seem strange that the dealers are included, but actually the dealers are themselves the heaviest users of light planes because of their school work, passenger hopping, and so forth. Students are all extremely anxious to buy planes, and generally select the type in which they have learned to fly. The business men are in a distinct group from the students. It is true that some successful business men learn to fly, but the majority either hire a pilot to fly for them or else learn to fly after the purchase. The wealthy sportsman is a comparatively easy man to sell.

Mr. Duels voices one very wise thought. "However, selling the planes to people who will use them for sport and pleasure alone is not following the guiding star of the industry. Such sales will continue in fair volume for a while and should be sought after, but the saturation point is soon reached on any product which does not have the practical utility appeal which generates volume sales. There are many pleasure yachts sold each year, but there is a vastly greater number of electric refrigerators being sold. The airplane is primarily a tool of commerce and industry, and we believe that our business of selling airplanes must be built from the ground up on a solid foundation of commercial application."

American Passenger Air Transport—III

(Continued from page 517)

we were still lagging somewhat behind European practice.

We do not believe, however, that this condition will long prevail. Consider, for example, the air depot of the Western Air Express at Los Angeles, California. The depot is not large but it is built in attractive Spanish style. There is a general waiting room, a special waiting room for women, a ticket office, suitable lavatory space, and a roof garden. On cool days there is an open fire to welcome the passenger. Private automobiles are stored without charge. The airplane is brought directly to the front of the depot. Here an extensible canopied walk has been provided, which may be made to inclose the door of the airplane, so that passengers are under cover at all times, and protected from propeller danger. Uniformed attendants carry baggage and are not allowed to accept tips.

SEE THE MARVELOUS SPECTACLE

in the sky through your own telescope, and details 20 miles away, by day.

Reflecting mirrors, guaranteed accurate by test, furnished on ground to order, 6" to 12", \$75 up.

Simple to make your own tube and mounting.

Prisms and eye-pieces all sizes and powers.



C. A. OLSON, Box 363

Westwood New Jersey

Waterpower Engineering

Home Study for High School Graduates

H. von SCHON, Consulting Engineer
289 Parker Street, Newark, N. J.

Inventions AND Patents

By Milton Wright

Sound practical advice to Inventors, covering the entire field from the inception of the idea through to the legal forms of assignment, sale or royalty, with numerous hints suggested by the experience of many years practice.

(\$2.65 postpaid)
DOMESTIC

SCIENTIFIC
AMERICAN

24 West 40th Street
New York, N. Y.

The Municipal Airport at Oakland, California, on the east side of San Francisco Bay, one of the busiest airports in the United States, will, when completed, present an imposing architectural appearance. As an indication of what the American passenger terminal is already like let us quote from Hank's "International Airports": "The airport buildings consist of four hangars with suitable shop facilities, an administration building and an airport restaurant. The hangars are constructed of masonry and steel and are of ample size to shelter the largest of transport airplanes, the total area providing in excess of 20,000 square feet of clear floor space. Hangar doors are all of full width opening and the overhead clearance of each is 24 feet. Floors are of concrete and aprons of the same material have been constructed in front of the hangars. The restaurant seats 150 people and is modern in every detail. A lunch counter is provided for those desiring rapid service. The administration building contains the office of the airport manager and headquarters of the various transport companies operating from the airport. A complete weather display board has been installed in this building on which full weather reports are posted several times a day. A club house for the use of pilots is now being erected."

The Future of Passenger Travel

IT is always difficult to predict, but there are certain conclusions which may be readily drawn from present trends.

Safety comparable with that of rail travel will be achieved within a few years. Increased safety, increasing propaganda by the press, the tremendous superiority of the airplane as regards speed, will eventually make the public completely air-minded. Passenger air travel will then be on a tremendous scale. The network of airways will cover the entire country, giving air travel facilities to every city of any importance.

Cruising speeds will gradually approach 200 miles per hour. Night flying for passengers and sleeper airplanes will become commonplace. Further improvement in the structure, aerodynamics, and power plant will greatly increase the payload capacity of an airplane. So will re-fuelling in the air.

The crowning technical achievement; a combination of all these elements will give us an overnight service from coast to coast.

Improvement in production methods both of plane and engine, greater skill in operation, a far greater intensity of air traffic and hence more intense utilization of material will all reduce the cost of air travel until it is but little greater than that of the best railroad travel.

Since the airplane causes distances to contract, systems covering a geographic area equal to, for example, that of the Pennsylvania Railroad, will appear small. The trend toward mergers and consolidations so strong in all branches of American business is already visible in aviation, as indicated by the formation of such huge concerns as Curtiss-Wright, United Aircraft & Transport, and Aviation Corporation. In air transport this trend is logical, good economics, and good engineering. Therefore, in a comparatively short time we shall witness the consolidation of the airways of the country in a few huge and powerful systems.

Air travel will become within 10 years well nigh universal.

THE END



Tuberculosis
might make her
an orphan

Help prevent it!

BUY
CHRISTMAS SEALS

The National, State, and Local Tuberculosis Associations of the United States

Our Choice of Recent Books

Modern Aviation Engines

By Victor Pagé

FORTY-SIX chapters describe the various leading American, English, French, German, and Italian aeronautical engines, considering thermo-dynamics, design, construction, repair, and trouble shooting. Diagrams and charts are especially clear and understandable and materials of construction, alloys, et cetera, are thoroughly covered. The most complete and up-to-date work that has yet appeared. Volume I includes general applications; Volume II describes individual motors, et cetera. Separately \$5.00 per volume. Both volumes, \$9.00 postpaid

Mechanics of the Gyroscope

By R. F. Deimel, Asso. Prof. Mechanics
Stevens Inst.

IN reality a text on the dynamics of rotation, this extended consideration embraces the gyro-compass and stabilizers. It presupposes a knowledge of the mechanics given in college physics although the subject is started at its beginning. There has been need for a work of this kind which covers the entire subject in a most complete and conclusive manner. \$4.20 postpaid

Beginnings of Telephony

By Frederick L. Rhodes

AN authoritative discussion of the problems surrounding the beginnings of telephony. Of special interest to inventors, lawyers, and students of our patent system as covering one of the great legal controversies which was definitely and finally adjudicated. The group of telephone cases was characterized by Mr. Justice Brewer as the most important litigation that has arisen under our patent system. \$4.50 postpaid

Edison His Life and Inventions

By Dyer, Martin and Meadowcroft

MOST happily timed to appear when all the world is celebrating the birth of the incandescent lamp, this biography which in considerable part is also an autobiography will be of particular interest as being personally authorized, the third editor being Mr. Edison's secretary for many years. Rich sources of original matter have been drawn upon and the complete work makes most fascinating reading, while the historical importance of such a record will be unquestioned. Generously illustrated with reproductions of unique photographs.

Two volumes—\$10.00 postpaid

Scotland Yard

By J. F. Moylan

WHAT Scotland Yard is and does, how the police work and live, the duties of uniformed and plain clothes men, the development of the detective force and the scope and methods of criminal investigation are fully described by one possessed of all the facts, yet the story is divested of statistics, being written for the general reader. An interesting resume of a famous organization. \$2.65 postpaid

Sparking of Steel

By E. Pitois
John D. Gatar

FACTS which everybody using steel should know. The illustrations present a complete practical series of spark streams and the contingent description is clear and concise, in understandable terms. A most valuable and interesting presentation of excellent format. \$2.15 postpaid

Drury's History of France

By Franklin Jameson
Mabell S. C. Smith

ONE of the well thumbed books in our library, for besides being the most authoritative, periods are presented in a style that is entirely removed from that of the textbook, and the grouping is one that carries on with a sequence like a story. This fourth edition continuing to the year 1929 will be welcomed in every library. It is interesting to note that reference to French history seems more often required than to any other history. \$3.90 postpaid

Principles of Economics

By F. S. Deibler, Prof. Economics, Northwestern Univ.

Price incorrectly quoted last month. Correct price is \$3.20 postpaid.

The Most Nearly Perfect Food

S. J. Crumbine
J. A. Tobey

YOU will be surprised to find that you know so little about the production, practical sanitation, and dietary functions of milk and its products. From the intriguing frontispiece to the last chapter "How the world gets its milk" you will find much that is interesting and profitable and all is told from a practical standpoint that will appeal to every consumer. As interesting a little volume as we have seen in many days. \$2.65 postpaid

Ends of the Earth

By Roy Chapman Andrews

THE story of the wanderings of this scientist explorer who has revealed, among other significant accomplishments, a new volume in the history of the earth. From a boy working his way through school doing taxidermy, to the leader of the large expedition into the Gobi Desert, the story grips one with its fascinating interest and importance. Sprightly told and abundantly illustrated. \$4.65 postpaid

Albert—King of the Belgians

By Evelyn Graham

THIS authorized biography of the most outstanding monarch of the war reveals intimately a character so heroic and so inspiring as to receive the unqualified admiration of the world. Wherever the subject touches other countries, new information of importance is added to that already available. One of the most interesting biographies we have read. \$5.20 postpaid

The Prince of Wales

By W. R. L. Townsend

THE biography of this most popular Prince told in an informal way that describes his likes and dislikes, his duties, amusements, accomplishments, and friendships. Many entertaining stories are told that show how keen he is and how he loves his people, with glimpses of the private life of the royal family. Through it all one sees the development of a personality and a character that is thoroughly likeable. \$2.65 postpaid

Foch

My Conversations with the Marshal

By Raymond Recouly

CLOSE comradeship up to the time of his death afforded the author unexcelled opportunity to record faithfully Marshal Foch's estimates of the men who fought against him, the Allied and political leaders, and his thoughts on the conduct of the War in general. As important as it is intimate and authoritative. Some of the opinions recorded are startling. \$3.20 postpaid

Bolivar

The Passionate Warrior

By T. R. Ybarra

A LINEAL descendent of a participant in the story of liberation which is described, the author had access to original material that adds greatly to previously recorded facts, and weaves a fascinating tale of adventure and patriotism comparable to the best historical fiction. A good subject, well written, and founded on long and careful research. \$4.20 postpaid

Twelve Royal Ladies

By Sidney Dark

ANOTHER title might almost have been chosen for this book—"Unhappy she who wears the crown," for ten of the subjects of these sketches never realized even average happiness. The author weaves an insight into the times while describing the characters in a style which is most readable and carries attentive consideration. \$3.15 postpaid

The Human Side of Science

By Grove Wilson

WE have had science presented to us from many angles but this work quite strikingly emphasizes the truth that it is something warmly alive; the truly great scientist having a definite kinship with the artist and poet. Ten years of research adds to the value of the interpretations of the great lives which are here sketched with appreciative understanding and the whole tone of the work is most elevating and inspiring. \$4.20 postpaid

The Wonderful Story of Science

By Inez N. McFee

SEVEN of the major sciences are viewed in a manner that points out the scope and most important facts of each, giving to the interested seeker a thirst for more extended study; each chapter may be considered as an introduction to the particular science it represents. An ambitious but quite successful treatment. \$2.65 postpaid

The Universe Around Us

By Sir James Jeans, Cambridge University

THIS new book, we predict, is destined to have as phenomenal and as deserved a sale among scientific thinkers both lay and professional as the equally brilliant, outstanding work of Eddington, "The Nature of the Physical World," has just enjoyed. If this prediction is fulfilled Jeans' book will become the outstanding scientific book of the coming season. Sir James Jeans is unquestionably one of Great Britain's three most famous and ablest cosmological thinkers. Fortunately he can and does write, not only so the average man can well understand him, but it has been commented again and again by other scientists that everything he writes seems to take on an enhanced fascination due to his own enviable manner of presentation. The present book has six parts: Exploring the Sky; Exploring the Atom; Exploring in Time; Carving out the Universe; Stars; Beginnings and Endings. Thus its scope is as broad as the universe, extending from microcosm to macrocosm. This philosophical work will stir profound thought in the reader who likes to think. Size 6 x 9; 331 text pages; 24 plates; clear type; good paper and binding. \$4.70 postpaid.

For Sale by SCIENTIFIC AMERICAN

Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

Reward Awaits Inventor of Machine

ALTHOUGH a reward of 25,000 dollars was offered as early as 1869 by the Government of British India for the invention of a machine that would separate the fibers from the stalk of the Ramie plant, the required machine has not yet been invented. Ramie is cultivated commercially in China and Japan, and might prove a desirable crop for the southern United States, according to the Department of Agriculture. The development of such an industry is awaiting the invention of a decorticating machine which will strip the fibers from the plant more economically than by the hand methods used in the Orient.

Ramie is a perennial shrub and belongs to the nettle family, but does not have stinging hairs. The fibers develop in the inner bark, and are removed by stripping the bark from the stalk, after which the fibers are scraped out by hand. The process corresponds to the scutching of hemp, but is essentially different. The fiber is remarkably strong, according to Mr. Lyster H. Dewey of the Bureau of Plant Industry, and it is adapted to many uses although it is not readily spun on spinning machinery designed for other fibers. Experimental plantings have shown that the crop would be well suited to the lowlands of the southern states. It grows in a warm, temperate climate with abundant rainfall and requires very fertile, well-drained soil.

Mr. Dewey has written a brief summary of the information available in regard to the plant, which has been published as Miscellaneous Circular 110-M, entitled "Ramie, a Fiber-Yielding Plant." This circular is available for free distribution to those who apply to the Department of Agriculture, Washington, D. C.

No Infringement in Old Process for Cleaning Neon Tubes

IN ruling that the defendant's process for removal of impurities from neon tubes before the introduction of the neon did not constitute an infringement of the process covered by patents held by Rainbow Light, Inc., the District Court for the Southern District of New York held that the process used by Claude Neon Lights, Inc., was in use long prior to the issue of the plaintiff's patent in 1925. Witnesses for the defendant testified that the process used by the Claude company had been practiced in 1923 and 1924.

The patent in question (Number 1618767) covers a process of purifying neon tubes by introducing a purging agent such as an alkali metal, causing it to co-act with the walls of the tube or with the impurities therein, subsequently evacuating the tube, and then introducing the neon. The process of the defendant, which was claimed to be an infringement, consists in evacuating sufficient air from the tube to permit an electrical discharge through it, and then

causing the discharge to take place until the wall of the tube is heated almost to the melting point, after which the tube is completely evacuated. No alkali metal is put into the chamber of the tube by any separate step such as the distillation or electrolyzation mentioned in the patent. The plaintiff contended that in heating the tube, some of the sodium is liberated from the glass and vaporized, and that it bombards the wall of the tube as described in the patent.

Although many scientific questions were raised at the trial, they were considered irrelevant to the case. Judge Coleman based his decision on the testimony of experts and the testimony of defendant's witnesses, the latter declaring that the process of the Claude company has been used in manufacturing neon tubes since 1923, or two years before patent was issued.

Patent Protection Still Effective

CRITICS of our system of patent protection have made many disparaging statements which seem to contain more breadth than depth. We are pleased to present an authoritative contribution from T. Hart Anderson, member of the New York Bar, which refutes certain unjustified criticism and shows that inventors may still sue all infringers excepting those furnishing infringing devices to the Government, and in such cases one may sue the Government. Judge Anderson's contribution follows:

During a recent conference with a client, an engineer, he advanced the theory that it was of no further use to patent inventions because one could no longer get protection under patent rights; that one could no longer sue the infringer. As a basis for this statement he called attention to a recent issue of *Engineers and Engineering* in which appeared an account of an address by Mr. Chester W. Cuthell of the American Bar Association, delivered at a meeting in Philadelphia held under the auspices of the Engineers' Club, the Aero Club of Philadelphia, the American Society of Mechanical Engineers, and the Philadelphia Chamber of Commerce.

What appears to be substantial foundation for the impression received by this engineer as to the ineffectiveness of patents is found in Mr. Cuthell's statement to the effect that, "The patentee couldn't even sue, and he can't today sue, the manufacturer, the outside manufacturer, who never invented anything, but who has used the invention supposedly covered by a Government patent."

The particular law to which the learned author takes exception is that which requires that suits for patent infringement be brought against the United States Government, and not against the manufacturer or contractor who makes for or furnishes to the Government anything which infringes a patent. This law provides that such suits shall be brought in the

Court of Claims. Mr. Cuthell asserts that this law is a war measure and should be "stricken down just as promptly as all other war measures should be stricken down." He particularly emphasizes the alleged bad effects of such a law as it concerns the aviation industry.

He states that Wright "has been out of invention for a great many years" and that Curtiss "has been running a farm in Florida." While deploring the loss to this industry of these two great figures, he attributes it to this law. It is further asserted that this law has interfered seriously with the financing of many inventions in the aviation business. Just what foundation he has for asserting that Wright and Curtiss are no longer interested in aviation inventions is not known. However, where they left off (if they have left off as stated by the learned author) thousands of other inventors are carrying on, making valuable improvements and inventions of importance to aviation, for which they are seeking and obtaining patents as usual.

When one appraises the remarkable progress of the aviation industry, and particularly of those companies engaged in producing airplanes and aeronautical equipment, it is hard to believe that this alleged objectionable law has had any effect whatsoever upon the financing of inventions or upon the industry as a whole. In a recent financial-statement issued by a leading firm of investment bankers, it is stated that "the United States not only has more airplanes in operation than any other country in the world, but the 1928 American production was greater than that of all the rest of the world combined." They further state that the production of airplanes increased more than 300 percent last year; that approximately 4500 airplanes and 3500 engines with a total value of 75,000,000 dollars were produced, and that the production of airplanes for the current year is estimated at 10,000 or 12,000.

This hardly looks as though the aviation industry has suffered because of this provision of the law, but still the learned author insists that it is unfair to inventors, for in the *New York State Bar Association Bulletin*, for September, there is a report of another address by Mr. Cuthell, delivered at the annual meeting of the New York State Bar Association. In this address he has this to say:

"The Federal law as to use by the Government of patents is very unfair to inventors. It was passed during the war as a war measure and it should be taken off the books. It prevents the patentee from suing a private infringer if the infringer is manufacturing for the United States Government, and gives the patentee only the right to sue in the Court of Claims for reasonable and entire compensation."

In this address the speaker seems to have discovered that the financial difficulties to which he referred in Philadelphia were nonexistent, because he refers to the fact that "during the past year there has been a

tremendous activity on the part of the bankers and lawyers in the financing of aircraft enterprises of all sorts." He also refers to the "activity on the part of the Patent Bar in respect to matters growing out of aviation." This activity of the Patent Bar, of course, negatives the idea that protection under patents can no longer be obtained because of this law.

Apparently Mr. Cuthell dislikes the fact that where the Government is involved one must sue the Government and not the manufacturer of the alleged infringing device, and that one must bring the suit in the Court of Claims. Now a suit in the Court of Claims is no different from a suit in any other Federal court. Anyone can get exactly the same relief so far as compensation is concerned as in any other court. It certainly is much better to sue a responsible government than an irresponsible individual or corporation.

In such a suit the Government can, of course, make the same defenses that any defendant could make, and the owner of the patent must meet such defenses in exactly the same way as he meets them in a suit in any court. The reason for this law, and its only effect, is to save the Government and those making devices for the Government from an injunction which might work to the disadvantage of the nation. Otherwise the owner of a patent in the aviation industry, or any industry, is at no disadvantage whatsoever.

Patents are just as effective as they always have been. It is just as desirable to patent inventions as it ever was, and except in the one instance where the Government is involved in the alleged infringement, the courts are always open to the owner of a patent. Wherever relief and compensation is justified, one may be sure that so far as the courts are concerned it will be extended.

Word Writing Machine Perfected

ONE of those inventions which startle even the most severe critic into a confession of amazement and admiration has been perfected and patented by Mr. Clyde C. Balston. His invention is a typewriting machine for use in offices, which prints words and phrases with about ten times the speed of a typewriter. It is designed for use in large offices, and does billing as well as writing of all kinds. The machine is about one and one half times the size of the customary typewriter, operated electrically and can be operated as a regular typewriter as well as a word and phrase writer. Its keyboard is a novel but not complicated departure from the keyboard of the typewriter; in addition to the "standard" arrangement of the keys, there are several auxiliary banks of keys which correspond to an ingenious chart containing the words and phrases which constitute about 99 percent of our usual vocabulary.

Mr. Balston has discarded the idea that every word we write must be decomposed into the individual letters by the typist, and then mechanically put back together again by the machine on the paper. As shorthand writers learned long ago when word signs first came into use, the single unit system is grossly inefficient. Instead of depending on the typist's artistic display of brain-and-finger gymnastics, the word writer attends to the composition automatically by means of an intricate assembly of rapidly revolving disks and combs inside the machine.

At the touch of two keys, one repre-

senting the initial letter of the word and the other a selector, the desired word is instantly and automatically impressed on the paper with the proper spacing and punctuation. Conventional phrases used over and over again in business correspondence are written in the same way—by pressing just two keys.

Misplaced Copyright Notice Void

NO protection was gained by placing the notice of copyright in all copies of a booklet on the last page, according to a recent decision of the District Court for the Eastern District of New York in a suit brought by United Thrift Plan, Incorporated, against National Thrift Plan, Incorporated. The misplaced notice was held not to constitute compliance with section 19 of the 1909 copyright act, requiring that notice of copyright be placed on the title page or the next page. To be relieved by the law, a plaintiff must have sought

to comply with the law, and in this case it was held that the plaintiff had knowingly neglected to follow the plainly stated terms of the statute.

The case was dismissed, but no counsel costs were awarded the defendant. The plaintiff contended that its rights were infringed, citing the fact that the defendant had published a booklet containing matter copied from the last page of the booklet bearing the misplaced copyright notice, and that the defendant must have known that the book was copyrighted. The court ruled that this contention could not be sustained no matter how strong might be the suspicion of its truth.

Section 19 of the present copyright act provides where the notice of copyright shall be placed, as follows:

"... one notice in each volume or number of newspaper or periodical. The notice of copyright shall be applied, in the case of a book or other printed publication, upon its title page or the page immediately

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Anyone desiring the address of a patentee listed in this section may obtain it by addressing Munn & Co.; those desiring official copies of patents herein listed, may secure them by remitting 15 cents for each one (state patent number to insure receipt of desired copy) to Munn & Co., 24 West 40th Street, New York City.

Pertaining to Aeronautics

AIRPLANE STABILIZER—Whereby means are provided for the shifting of ballast and manipulating the wings for stabilizing the plane while in flight should the equilibrium be disturbed by any of the influences to which such apparatus is subjected. Patent 1727275. Federico G. Diago.

AIRPLANE CONSTRUCTION—A unit comprising a Venturi tube, a propeller just in advance of, and extending a trifle beyond the rim of the tube, and a second propeller disposed inside of the rear of the tube, and rotated in an opposite direction to the first propeller for propelling an airplane. Patent 1727542. Albert C. Gienger.

WATER DRAWING APPARATUS FOR AIRCRAFT—Which permits water to be drawn into the aircraft while the latter is in motion, the device will not interfere with the landing gear, being movable by pneumatically controlled mechanism from operative to inoperative position. Patent 1729558. Vincent Strafino.

Pertaining to Apparel

SHOE-BUCKLE HOLDER—Constructed from a single sheet of resilient material, which may be readily secured to the upper edge of the shoe vamp so that a buckle may be detachably connected and rigidly maintained in applied position. Patent 1727650. Fred F. Kohn.

CORSET—Having novel means for concealing the adjustment portions in order that the outer part of the corset may be relatively smooth, and obviate the adjustments showing through the outer garments. Patent 1728985. Earle B. and Amy Stewart.

Chemical Processes

METHOD OF CARBONIZING A CELLULOSE-CONTAINING SUBSTANCE SUCH AS WOOD, PEAT, AND THE LIKE—Consisting in thoroughly soaking the said materials with a concentrated solution of calcium-chloride, adding thereto a small amount of hydro-chloric acid and heating the mixture at a pressure of less than fifteen atmospheres until said cellulose-containing

material is carbonized. Patent 1728807. Carl G. Schwalbe.

TREATMENT OF FELT AND FELT-HAT BODIES—For increasing the lustre, by placing the hat bodies into an aqueous solution of a complex compound of a heavy metal, at a temperature below boiling point, for some time under slow agitation. Patent 1729474. Erich Bohm.

Designs

DESIGN FOR A RADIATOR-CAP ORNAMENT—Patent 79333. Biagio Intingaro.

DESIGN FOR A MIRROR OR SIMILAR ARTICLE—Patent 79394. Rose Statella.

DESIGN FOR A VANITY CASE—Patent 79421. Leonard Friedberg.

DESIGN FOR A STATUETTE—Patent 79515. Mildred C. Gresham.

Electrical Devices

ELECTRIC MOTOR—Of the solenoid type, whereby a relatively high torque and speed of the revolving elements or armature may be obtained, adapted to operate from either alternating or direct current. Patent 1728054. Alexandre F. Godefroy.

STATIC ELIMINATOR FOR RADIO RECEIVERS—Which intercepts undesirable electrical impulses before they reach the receiving apparatus, by means of an air gap whereby such impulses may escape, and a sounding metallic screen upon which said impulses may impinge before being grounded. Patent 1728057. Watson E. Grimm.

ELECTRIC LIQUID HEATER—For heating water or other liquids, the principal object being to so arrange the bottom terminals that short circuiting by virtue of an accumulation of sediment will not occur under ordinary circumstances. Patent 1729587. Barnett W. Macy.

Of Interest to Farmers

STANCHION HALTER—For use in holding the heads of cattle rigidly in their head stanchions for performing any necessary operation thereon, such as de-horning, permitting the operation to be performed in the animal's stall. Patent 1727290. George A. Jones.

following, or if a periodical either upon the title page or upon the first page of text of each separate number or under the title heading, or if a musical work either upon its title page or the first page of music." Copyright is secured by publication of the work with the notice of copyright required by the act.

Copyright for Photographs

RECENT changes in the regulations governing copyrights have increased the cost of copyrighting a photograph. The charge is now one dollar when no certificate is desired, and two dollars when a certificate is requested. Using the proper blanks, photographs may be made and prints sold the same day with complete copyright protection, if the blank is filled out and immediately mailed with two copies of the photograph and the one dollar fee. If one wishes to have a minimum amount of lettering appear on the face of the print, one may use the letter C within a circle followed by the initials or monogram of the photographer. When this is done, "Copyrighted by" and the full name of the photographer must appear on the back of the photograph.

If the above form is not used, the words "Copyrighted by" and the full name of the photographer must appear on the face of the print within the picture area. If pictures are produced and sold without the copyright notice they cannot be protected by a later application for copyright. Every print made from a copyrighted negative must bear the copyright notice. For this reason it is best to place the copyright on the negative itself.

Any person who contemplates copyrighting photographs should procure application blanks and complete information from the Registrar of Copyrights, Library of Congress, Washington, D. C.

Method Patented for Improving Celery

GOING beyond the prior art, which disclosed a method of treating citrus fruits for the purpose of changing the color of the skins, a method has been patented which improves the edibility of the product, which in this case is celery. The new method of treating celery consists in applying unsaturated hydrocarbon gas mixed with air, rendering the celery less bitter, less stringy, and more edible, as well as changing the color.

The claim rejected by the examiner and later allowed by the Board of Appeals of the Patent Office reads as follows: "A method of treating leafy green vegetables to remove acrid bitter green substances, which consists in exposing the vegetables to the action of ethylene, admixed with air in proportions ranging from one part of the gas to one hundred thousand parts of air to one part of gas to one hundred parts of air."

The patent was issued to Rodney B. Harvey. In commenting on the older Denny patent for coloring the skins of citrus fruits, the opinion states that the prior art process did not solve the appellant's problem of making the product more edible.

"There was nothing in the Denny treatment," according to the decision of the Board of Appeals, "that would teach or suggest that the same method could be employed to convert a bitter substance

COMBINED ROD AND GUN—Especially for spraying, so formed that it may be used under low shrubbery, or for fruit trees at a height of six feet or more, directing a stream not injurious to blossoms, fruit or leaves. Patent 1728455. Ernest C. Taylor and David B. Mackie.

Of General Interest

CIGARETTE-MAKING APPARATUS—A readily manipulable apparatus which is portable and adapted to be used by any smoker for making a single cigarette with ease, or may be used for the manufacture of cigarettes commercially. Patent 1726368. George P. Silke.

DISPENSING VALVE—Which embodies novel features of construction rendering it practically leak-proof, reliable and effectual in operation, particularly adapted for discharging quantities of liquid soap. Patent 1726402. Winfred N. Lurcott.

BUILDING CONSTRUCTION—Consisting of a steel framework so formed that it may be readily assembled in the field without the use of rivets, designed for relatively light work, such as private homes, small buildings, garages, etc. Patent 1726400. Henry B. Littlefield.

PROCESS OF MAKING A WASHING LIQUID—Which comprises a mixture of sodium carbonate, pulverized lime stone, and calcium chloride, will remove grease and other foreign matter from fabrics without injury to the article, may be used in combination with ordinary washing soaps. Patent 1728082. Eugene Scales.

HAIR-WAVING DEVICE—Designed to conform to the head of the user and so constructed that when a number of them are engaged with the hair side by side, uniform and continuous waves will be formed. Patent 1727218. Alexander J. Rusak.

FOLDING ARM-CHAIR—Which may be folded or set up by a simple relative movement of the seat with respect to the back, which may be accomplished with one hand only, accidental collapsing is prevented. Patent 1727255. Finn Simmons.

TIE RACK—Formed of a single strip of metal horizontally disposed to receive ties, a plurality of points to prevent slippage of the ties, and a bracket for securing the supporting means to a wall or fixed support. Patent 1727269. Robert L. Bee.

CAPS FOR CONTAINERS—Having threaded discharge necks, wherein the cap may be readily screwed into place or removed, and may be moved to an open position without being disconnected by means of a swinging structure. Patent 1726966. Fred and Walter Schlayer.

STRUCTURAL-STEEL FRAMEWORK—A supplemental column for partially supporting the gravity load to relieve the main columns thereof, and to lend to said main columns a greater wind stress capacity than could otherwise be sustained on a given area, allowing a building to be erected to greater height than heretofore possible. Patent 1726844. John A. Larkin.

ASPHALT PAVING COMPOSITION—Which incorporates asphaltum in impalpable powders to produce synthetic rock asphalt having all the desirable properties of natural bituminous rock asphalt capable of being shipped in granular state without forming a mass. Patent 1727231. James S. Downard.

JOINT FOR STRUCTURAL-STEEL COLUMNS AND GIRDERS—Including integral wing gussets projecting in different planes which permit direct attachment of the girders to the column, thereby eliminating connections by angles and hence placing all rivets in shear which establish such connection. Patent 1727293. John A. Larkin.

METHOD FOR PHOTOGRAPHING OBJECTS—Which permits the making of photographic reproductions either in exact, reduced, or enlarged size, without focusing in the usual manner, by means of a compass with identical scales corresponding with graduated readings on movable parts of the camera. Patent 1727288. Carl G. Johnson.

contained in the edible portion of the vegetable to sugar. We believe that even if it occurred to anyone to blanch out the green appearance of celery, he would expect no more than the change in appearance, and that the sweetening and reduction in stringiness would be a surprise and therefore an unobvious result. We therefore consider that the teachings of Denny do not constitute anticipation of the claims of this application."

New Insulating Material Patented

AN electrical insulating material composed of the fiber obtained from certain portions of the leaves of the Bromelia family has been patented by Harold H. Brown (Patent Number 1725335), who is credited with having been the first person to discover that the fibers have superior and unexpected electric insulating properties. The claims were allowed although a prior description was found of paper made of such fibers being used for insulating purposes, but it was shown that previous investigators had only contemplated the use of the material for making a "strong wrapping paper and a heat-insulating paper for use in refrigeration chambers or private houses."

All of the claims had been rejected by the examiner, but the Board of Appeals reversed his decision. An affidavit from the vice president of the Western Electric Company was submitted by the applicant, in which it was stated that paper represented to have been made from the fiber of the plant "caroa" and supplied by Mr. Brown was tested and proved efficient as an insulating material and better than most of the insulating materials commonly used for wrapping wires in telephone cables. It was also stated that the material was first brought to their attention by Mr. Brown, and that the company had entered into a contract and paid him a substantial sum for the right to use it.

Trademark for Grapes Held Invalid

REFUSING to restrain other dealers from using the name "Lady Finger" for a variety of grapes, although the owner of a trademark covering the name had sought an injunction, the Ninth Circuit Court of Appeals decided that the name "Lady Finger" is not a valid trademark but is the name of a variety of grapes. The court pointed out that there was no effort on the part of the defendants to simulate the plaintiff's labels or to in any way indicate that the grapes were produced or packed or marketed by the holder of the trademark, other than by the use of the name "Lady Finger" indicating the variety of the grape contained in the package.

The case was brought by A. B. Humphrey Company against Ben H. Arkelien and others, on appeal from the District Court for the Northern District of California. The law of the State of California stipulates that boxes containing grapes must be marked with the name of the variety, and designates one of the varieties as "Lady Finger." The higher court ruled that the defendants were entitled, if not required, to use the name in designating the variety of the grape packed and shipped by them. The appellant's plea for relief by injunction was denied, in view of the opinion that the name "Lady Finger" was not valid for trademark use, although registered.

ICE CREAM CONTAINER—Which maintains the ice cream frozen and yet entirely isolates the ice and salt from the ice cream and from the opening through which access is had to the ice cream. Patent 1726469. Charles M. Brenner.

PENCIL SHEATH—A sheath which is adapted to be positioned within a garment pocket for the reception of a pencil, whereby to prevent casual displacement or loss and to protect the point against breakage. Patent 1728128. Nobuyoshi H. Kodama.

BATH SPRAY APPARATUS—A shower bath spray attachment which is adjustable vertically to suit the convenience of the person using the same, and is arranged to be detachably supported from a shower bath curtain. Patent 1728129. Harry Madison.

CONTROL DEVICE FOR STOVES—Which serves the purpose of automatically shutting off the supply of gas to the burner of the stove, by the overflow of any liquid, such as coffee, tea or water being boiled on the stove. Patent 1728107. Charles F. Conover.

LOOSE-LEAF BOOK—Having leaf-holding means which serve advantageously for pocket size books with flexible covers, and will not make the book bulky at the back, the construction is simple and inexpensive to manufacture. Patent 1728078. Antti Polkko.

CAKE AND PIE TIN—Of substantially conventional construction but having associated therewith a specially constructed cutter or knife for readily separating the pie or cake from the container, while at the same time presenting means which form a handle. Patent 1728087. Clyde W. Stuart.

PRICE-TICKET HOLDER—Having movable spring actuated cooperating parts so constructed as to hold an indicia bearing card in such manner that it may be readily gripped for the purpose of removal from the holder. Patent 1728789. Francis Devins.

INTERLOCKING JOINT FOR STEEL CONSTRUCTION—Which enables all parts in connection with building frame structures to be interlocked and securely welded so that the structure becomes integral without the use of rivets, thus doing away with noise. Patent 1728782. Charles Carmichael.

RETAINING DEVICE—For adjustably and detachably holding, and for forming a brace between relatively movable parts of an article, such as a folding chair, or other articles to be held in different adjusted positions. Patent 1728849. Arthur F. Bailly.

ROOF—Which includes a waterproof base and a mastic which will substantially fill the interspace between slates, thereby eliminating the necessity for overlapping the slates, yet the roof will be entirely waterproof. Patent 1728795. James H. Griffin.

FISHHOOK DISGORGER—Which may be easily operated, and is so constructed that after being released the point of the hook is protected to prevent its re-engagement during its withdrawal from the mouth of the fish. Patent 1728864. Henry A. Kramer.

BOTTLE OPENER—Which may be used either for removing bottle caps, or withdrawing corks, being so constructed that the insertion of the corkscrew will operate to exert a pulling action to automatically withdraw the cork. Patent 1728787. Joe de Bracht.

SUBMARINE RESCUE DEVICE—For persons confined in a submarine which has been sunk and cannot of itself rise to the surface, an attachment being provided which will present by a signal at the surface the location of the submarine, whereby communication may be readily provided for releasing the persons, or supplying air, without an appreciable amount of water entering the submarine. The inventor has been granted two patents, 1728808 and 1728882. Yoshi Shimizu.

WATCH-HOLDING ATTACHMENT FOR BELTS—A belt having a novel type of clip for anchoring the end of a pocket watch chain, either to the belt or to the strap of a wrist watch, which may be mounted on the belt. Patent 1729578. Frank Gogan.

PROCESS OF ARTIFICIALLY AGING TOBACCO—Which includes the steps of steaming the tobacco with a cereal grass extract, then packing and sweating the tobacco, then again moistening the tobacco with the extract and re-packing and re-sweating. Patent 1729482. Thomas H. Keller.

ARTICLE REST—For fragile articles such as bottles, particularly nursing bottles, whereby a baby may feed from the bottle in reclining position, without the employment of other means of support and without liability of accidental displacement. Patent 1729531. Charles N. Wolever.

HOTEL ROOM SERVICE-TABLE—For serving meals in the private rooms of hotels, the table being constructed to include a heating cabinet to permit the complete transportation and service of an entire meal by a single waiter at one trip. Patent 1729491. Frank Rygl.

RESTING DEVICE—Whereby the head or other portions of the body may be comfortably supported for a period of time, as in hair curling where heavy electrodes are attached, to the head, thus eliminating fatigue during the operation. Patent 1727751. Frances M. Davenport.

FLOAT VALVE—Of simple construction, and not easily liable to get out of order, for use in conjunction with water flush tanks for controlling the filling of the tank. Patent 1729484. Francis E. Lee.

EXERCISER—In which the resistance may be varied according to the physical condition of the person using it, the hand grips being so arranged as to permit the change of elastic elements of various thicknesses. Patent 1729399. Roy H. Noe.

FASTENER—Having a head adapted to be inserted through a slot, eyelet, or other opening, and then turned to transverse the opening, may be constructed as a curtain fastener, or in a collar button type. Patent 1729489. Frederick C. Rile.

FLUSH LEVER—Having a stem and adjustable collar which make it readily possible to adjust the height to which the flush ball may be lifted without rebending the lift wire, particularly adapted for closet tanks. Patent 1729546. Herbert B. Myers.

Hardware and Tools

DEVICE FOR PICKING FRUIT—A light-weight tool having a blade and a dependent finger-receiving portion so that the fruit can be cut without disturbing the rest of the hand which may be engaged in holding a fruit container. Patent 1727286. Allie H. Hamre.

WELDING TONGS—A tong particularly adapted for use in electric welding, characterized by the ease of manipulation and the ability to firmly grip electrodes of different sizes or release them at will thereby facilitating welding operations. Patent 1726624. Ernest S. Lawson.

CUTTING INSTRUMENT—A double acting multiple instrument adapted to simultaneously operate in opposite directions a plurality of tools such as saws or choppers, particularly adapted for use by butchers. Patent 1726863. Samuel Singer.

AUXILIARY LINK—Composed of two identical U-shaped parts that may be removably secured together without any fastening devices being necessary, and will bind together more tightly as greater tension is applied. Patent 1726654. Knut A. and Klaus E. Dahlgren.

SHREDDER—A kitchen tool formed of non-corrosive or rustproof material and capable of being used for shredding edibles, such as pineapples, the knives being readily adapted for cutting the meat of the fruit into shreds. Patent 1728801. Margare M. McCutcheon.

LIFTER FOR STONE BLOCKS AND THE LIKE—A heavy metal tool which may be quickly applied and removed and will securely engage the block, and cannot be released until the stone engaging elbow is unscrewed. Patent 1729467. William S. Whyte.

JOINT RE-ENFORCEMENT FOR METAL DOORS OR THE LIKE—A wrought metal re-enforcing block for the joints of hollow metal doors, including a pair of plate members flanged on two sides and secured together with the flanges overlapping and the plates spaced apart. Patent 1729586. Louis Liebman.

CASING SPEAR—Which is capable of being operated from the top of a well to grip a casing at any point so that the casing may be pulled from the hole, or the sections unscrewed or screwed together. Patent 1728136. Edward D. Power.

Heating and Lighting

SECTIONAL BOILER HEADER—An air-tight joint or seal between the contacting faces of boiler header sections whereby the passage of air between the header sections is obviated, particularly adapted for steam boilers. Patent 1729487. Edwin C. Ramage, Jr.

Machines and Mechanical Devices

SAWMILL—Making use of but one engine, it does not move the log against the saw, but advances the saw against the log, thus eliminating waste motion, is readily transportable and adapted for sawing railroad ties. Patent 1725295. Rober H. Orr.

FLEXIBLE MECHANICAL POWER TRANSMISSION—Primarily intended as a gear for transmitting, without lag, the power generated by a constant torque prime mover, such as a steam turbine or internal combustion engine, driving machine tools and pointing guns. Patent 1727232. Stephen A. Farrell.

WATER-LIFTING APPARATUS—Which will not only be mechanically efficient, but will be simple, of practical construction, rugged and durable, suited to the requirements of economical installation and inexpensive to operate in elevating water. Patent 1727216. Thomas J. Porter.

DISPLAY DEVICE—In which the exposed matter is continuously changing, the driving mechanism simple positive and smooth in operation, and the displays brought into view each being removable. Patent 1726605. James S. Anderson.

VALVE GRINDER—Which may be tilted at any angle from the vertical during the operation of grinding the valve, an adjusting plate is resiliently supported at one end of a rotatable barrel for carrying a valve wrench. Patent 1727292. Joseph R. Keiper.

TENSION DEVICE FOR SPINNING MACHINES—An attachment, to co-act with upper delivery rollers whereby the core yarn is maintained under positive tension as it is advanced between the usual rollers of the machine, with the roving strand. Patent 1728066. Giles A. Lay.

PUMP VALVE—Characterized by its ability to seal itself in closed position against possible leakage through the port which it controls, particularly adapted for slush pumps as used in drilling oil wells. Patent 1725297. John L. Paterson.

AUTOMATIC COAT-HANGER MAKING MACHINE—Which will take the rough wood, chip the ends, bevel the top, for providing a smooth garment-supporting surface, drill an opening in the center, insert a wire, bend a hook, and discharge the complete hanger. Patent 1727513. Earl B. Maloon.

PRINTING-PRESS FEEDER—Having means which allows envelopes to be stacked flap downwards, and to be individually advanced into printing position, and a pushing element which separates the envelopes after the printing operation is completed. Patent 1724199. James W. Hoag.

GARMENT COUNTER—Particularly adapted for stockings, wherein counting mechanism is automatically operated as the garments are placed in a holder which is automatically closed when a predetermined number have been placed therein. Patent 1729497. John K. Voehringer, Jr. and Robert A. Gibbs, Jr.

BACON SLICER—An adjustable slicing machine wherein bacon or other meat may be supported and fed either horizontally or upwardly on an incline to a cutting knife which functions regardless of the angle of the bacon. Patent 1728843. Max Trunz.

SEPARATOR—For separating solid particles from a moving gas stream, comprising a hollow casing of V-shaped cross section, and separated V-shaped partitions through which the gas moves, and means for continuously flushing the centers with a liquid. Patent 1728877. Albert R. Mumford.

LADDER—For use in connection with fire fighting apparatus, which is automatically actuated and vertically adjusted to height by means of a pressure responsive mechanism, and sustained at any desired angle about two right angularly disposed axes. Patent 1728854. Melvin K. Carr.

TAPE-FEEDING MACHINE—A tape feeding and moistening machine in which novel means is actuated for automatically cutting off the tape when the tape feeding means is manually released. Patent 1726883. Rufus M. Brooks.

FINISHER—Especially constructed for shoe-polishing machinery, in which a long shaft supports polishing wheels of different shapes, these wheels carrying wax that is kept in a warm condition for use at all times. Patent 1726888. Robert J. Crossman.

FAN MOUNTING—Arranged in such a manner that the rotation of the fan causes the mounting means and the fan to revolve so that the direction of the air current caused by the fan changes continually. Patent 1726881. Ralph N. Berryman.

MIXER—For grain, having a novel form of casing for thinning out the grain, and causing all the grain to flow from top to bottom, and then to be conveyed back, for repeating the operation. Patent 1728411. Oliver O. Howard.

COTTON CLEANER—Which removes foreign material from cotton either before or after ginning, by mixing air with the cotton in a manner to force out the heavier particles, while collecting the cotton through an independent path. Patent 1729503. Cary S. Cox.

TENSION DEVICE FOR SHUTTLES—Wherein the shuttle may be quickly threaded either automatically or by hand and maintained in threaded position while remaining under tension, the guiding eyes are formed to be readily removed, and the tension varied. Patent 1729551. John Rush.

SHAFT HANGER AND BEARING—Including casing sections each fashioned from a single sheet of material with one section having its edges rolled to secure the other in mated relation, whereby the sections will retain ball bearings against axial separation. Patent 1729499. Theodor Anthoni.

Medical and Surgical Devices

DENTAL BITE METHOD—Including floating partially submerged, two superimposed "bite forms" in a heated liquid until one form becomes softened to a greater degree than the other, with the inside or core of each form remaining hard. Patent 1728199. Abel O. Eberhart.

APPARATUS FOR CONTAINING OR RETAINING THE HUMAN BODY OR THAT OF ANIMALS, FOR MEDICAL, SURGICAL, AND HYGIENIC PURPOSES—A flexible retaining article formed of india-rubber bands, perforated with a large number of holes which ensure proper aeration and evaporation, linen protecting and isolating the rubber from the skin. Patent 1729502. Louis M. Clement.

Musical Devices

BRIDLE STRAP FOR PIANO ACTION—Which is capable of being quickly and securely applied to a piano action without dismembering the latter and is sufficiently strong to minimize breakage and resist the usual effects of such straps. Patent 1727502. Hiram E. Chute.

VIBRATILE MUSICAL INSTRUMENT—Comprising a metallic bar having a vibrating center adapted to be struck, and dead metal adhered to the bar at one end which functions to prevent harmonics and overtones but permits the hum to predominate. Patent 1727238. George E. King.

VALVED BRASS INSTRUMENT—Wherein a valve or series of valves may be used in connection with wind instruments such as cornets or horns, to entirely eliminate distortion of the sound wave in its journey through the tubes. Patent 1729568. Ernest A. Couturier.

Prime Movers and Their Accessories

MOTOR—Of the multi-cylinder type, which eliminates crank arms, and wherein the piston rods are arranged for operating cams carried by oppositely disposed shafts so that rotary movement is imparted in the downward movement. Patent 17428. (Reissue). Paul Marchetti.

INTERNAL-COMBUSTION ENGINE—In which means are provided for directing a new charge of gas into a cylinder in such manner as to cause this charge to force the exhaust gases out, without mixing with them. Patent 1728472. Gustave H. Brekke.

Pertaining to Recreation

GOLF-BAG SUPPORTING DEVICE—Which has novel means for automatically actuating supporting members when the bag is placed upon the ground, and releasing the supports when the bag is raised, the device may be secured to any size or type of bag. Patent 1727612. George W. Lescher.

SWIMMING APPARATUS—Comprising a floating casing with a propeller which is arranged to receive its rotary movement by the simultaneous action exerted by the hands and feet of the swimmer on two pairs of cranks. Patent 1728103. Rene G. Chaligne.

TOY—By which children may obtain the pleasurable benefits of a teeter, the construction being such that the seat and foot rest may be readily adjusted to accommodate children of different sizes. Patent 1729214. Benjamin Gordon.

TOY VEHICLE—Having a removable body associated with the chassis of the vehicle to provide a wagon when in applied position, yet when removed from the latter, is convertible into a sled, providing amusement both summer and winter. Patent 1728587. Daniel L. Aldridge.

Pertaining to Vehicles

CHILD'S AUTOMOBILE CHAIR—Which may be maintained in anchored position by the weight of an adult so that the child may be readily attended to directly over the lap of the person, who is relieved of the child's weight. Patent 1723899. Robert C. Sturges.

LIGHT-RAY PROTECTOR AND HOLDER—Which will contribute to safety in driving a motor vehicle, by providing a glare shield against the lights of approaching vehicles, and a simple holder for the shield, composed of jointed sections. Patent 1720199. Lon H. Barringer.

CLUTCH-PEDAL CONTROL—Which may be readily attached to the frame of an automobile and adjusted for automatically stopping or checking a clutch pedal in its neutral position, particularly adapted for use on Ford cars. Patent 1720075. George F. H. Hicks.

TIRE-RIM TOOL—Which can be quickly connected to a rim, and when actuated for collapsing the rim will first spread the ends apart and permit the ends to overlap each other during the remainder of the operation. Patent 1717806. Lisle H. Nicholson.

AUTOMOBILE OIL RECORD—In which certain data may be displayed on the instrument board, whereby the operator may be informed as to the time when the oil was last changed and when it should be changed again. Patent 1717848. Ralph E. Maxwell.

SCRAPING DEVICE FOR FOOTWEAR—In the nature of an attachment capable of being readily applied to an automobile running board in an inconspicuous and unobstructing position, for removing dirt adhering to the footwear, thus preventing soiling the floor covering. Patent 1718428. Frank P. McNulty.

AUTOMOBILE LICENSE-PLATE ATTACHMENT—Which is applicable to a license plate for indicating the current year, being substituted by a similar one in the new year, in this manner the attachment could be renewed annually instead of the entire license plate. Patent 1720258. Hugh D. Barnett.

SWITCH FOR AUTOMOBILE SIGNALING APPARATUS—Which may be readily attached to the steering column of a car and will enable a driver to indicate to drivers of other cars his intended change of course by a "right" or "left" turn. Patent 1723845. Charles J. Diehl.

TROUBLE - LIGHT - MIRROR SYSTEM—In the form of a set of adjustable mirrors which may be associated with the headlight of a car in such manner that the light will be transmitted by reflection to any desired point. Patent 1723863. Robert Jeffrey.

COMBINED LICENSE-PLATE HOLDER AND SIGNAL—Including a casing in which a license plate is sealed against unauthorized removal, and carrying means for lamps to illuminate the license, the right and left turn signals, and a tail light. Patent 1723463. Henry Brewster.

ROAD FINDER—Adapted for connection with the usual speedometer gearing, for giving a driver traveling a strange road, the "right" and "left" turns, the side streets, condition of the road to be traveled, garages, and hotels, in advance. Patent 1725644. William H. Kirby.

AUTOMOBILE SIGNAL—Automatically actuated through the movement of the brake or clutch pedal, and including mechanism whereby the pivotal motion of the foot pedal is transformed into relative rotary motion of a signal arm. Patent 1726443. Benedict Mayer.

DIRECTION INDICATOR—Which is convenient to handle, does not require complicated working mechanism, and may be readily secured to any type of vehicle, indicating direction to other drivers or pedestrians, by means of a pointer and light signals. Patent 1725248. Eugene A. Bradbury and Wilford B. Holland.

AUTOMOBILE SIGNAL—Compact in form and adapted to be controlled by an electric switch which may be disposed on the instrument board, steering wheel, or other place within convenient reach of the car operator. Patent 1726961. Frederick L. Marsh.

AUTOMOBILE TOP PAD—Which may be included with the original construction of a car or incorporated into tops already built, for preventing injury to the heads of occupants when subjected to sudden jolts. Patent 1728093. George E. Wintz.

GLARE SHIELD FOR REAR-VIEW MIRRORS—Which will permit a screen to be drawn across the face of the mirror and secured for the purpose of protecting the eyes of the driver from the glaring headlights of a following vehicle. Patent 1728123. William E. Hummel.

MASKING TAPE—Comprising a strip of flexible material narrow in width and having adhesive sides for permitting a protecting paper to be secured for protecting the painted parts of an automobile body. Patent 1726744. Albert J. Krug.

DUMP-BED HOIST FOR TRUCKS—Which automatically raises or lowers a truck bed when the operator moves a control lever, and automatically returns the control lever to neutral position, after the bed has been moved to its uppermost or lowermost position. Patent 1726723. George T. Summers.

DEVICE FOR PREVENTING RETROGRADE MOVEMENT OF VEHICLES—Through the action of a locking device directly associated with the drive shaft of an automobile which will prevent retrograde rotation of the shaft when the car is located on an inclined road bed. Patent 1728809. Alfred B. Small.

INDEX TO VOLUME 141, JULY-DECEMBER, 1929

Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications "Aviation," "Engineering," "Household," "Medicine," "Miscellaneous," etc., under which many items will be found, the location of which otherwise would be very puzzling.

A	
AGRICULTURE	
Bees, Honey, Home of	158
Celery, Improving	554
Fur Farming Misconceptions	477
Insect Pests, Crop Destroying	124
Pecan Oil from Wastes	525
Pest, a 50,000,000 Dollar	181
Potash, New Sources of	252
Reindeer as a Source of Food	104
AIRPLANES. See AVIATION.	
AIRSHIPS. See AVIATION.	
ANTHROPOLOGY. See ARCHEOLOGY.	
ARCHEOLOGY, ANTHROPOLOGY, AND ETHNOLOGY	
Africa, South, What the World Owes to	119
Ancient History from Aloft	242
Antiques, Fake	335
Arabia, North, Early Man in	503
Archaeologist's Note Book	502
Archaeology, Behind Scenes of	492
Art of Pliocene Man	508
Australian Bushman, Modeling a	287
Cave Man	478
Cave Man's Brain	544
Dentist, Prehistoric Indian	544
England, Invaders of	16
Flint Mines of Grime's Graves	394
Food Distribution, Archeology Solves Problem	502
French Cave Men	478
Herculaneum, Discoveries at	334
Jerusalem, Walls of	60
Kish	151
Lindbergh, Scientist	477
Magnifying Glasses Helped Egyptians	66
Mammoth's Tooth	524
Marble Sculpture and Ultra-Violet Ray	503
Medium, False Pyramid of	502
Mongolians, Slanting Eyes of	86
Mousterian Man	472
Nemi's Barges, Uncovering	35, 334
Pliocene Man, Art of	508
Race, Extinct	472
Reindeer Roamed the Pyrenees, When	478
Sculpture, Prehistoric	478
Scythian Bronzes	502
Sinal	376
Sumerian Harp	492
Ur	492
ARCHITECTURE. See BUILDING CONSTRUCTION AND FINE ARTS.	
ARMY AND NAVY.	
Boilers, Lowering Huge	482
Fleet, Salvaging a Scuttled	473
Guns, California's	14
Japan's New Navy	396
Mechanized Force, Our Army's	216
Naval Accord, Jeopardizing	381
Naval Reduction and Parity	320
Parity and the Public	289
Pensacola, Launching of	15
Rifles, Designs for	526
Tank, British	111
Tank, Fighting, Our Newest	246
Torpedo Plane Suit	267
ASTRONOMY	
Amateur Astronomer	82, 176, 258, 354, 448, 542
Amateurs, Practical Astronomy for	426
Canned Astronomy	200
Comets, Puzzles of the	400, 496
Earth Shine	30
Heavens Month by Month	84, 182, 262, 356, 450, 542
Jungfrau Observatory	14
Meteor, Large, Falls	323
Meteors	316
Planetarium	200
Planets, Puzzle of the Major	138
Star Light, What Becomes of the	220
Star Maps	84, 182, 262, 356, 450, 542
Telescope, Silvering World's Largest	225
Telescopes, Amateur	82, 176, 258, 354, 448, 542
Telescopes, Large, Designing	237
ATHLETICS. See SPORTS.	
AUTOMOBILES	
Automobile Uses 100 Chemicals	350
Automobile Parts, "Just-as-Good"	267
Banking by Auto	344
Brake, Hydraulic	180
Cape to Cairo Highway	154
Elephants Should Carry Lights	109
Gasoline and Alcohol Mixture	438
Highway Safety Illumination	434
Motorists, Sudden Death of	74
Road for Motorists, Thrill	14
Roads, Ugly	381
Sand Spreaders, Anti-Skid	162
Street Cleaning Trucks, Sanitary Bodies for	160
Ventilator for Rear Window	162
AVIATION	
Air Country Clubs	205
Aircraft, Exporting	249
Aircraft Sales, Financing	249
Airplane Catapult	293
Airplanes in 1936, How Many in	164
Airplanes Tested in Tunnel	15
Airport Competition, Lehigh	71
Airport Sign and Signal	73
Airport "Stop-Go"	287
Airports	282, 298
Airports and Airways	164
Airship, Metal-Clad	436
Airship Travelers	483
Air Tour, Fifth National	164
Air Transport, Passenger	324, 404, 514
Altway Marking	528
Altimeter, New	336
Altimeter, Radio	528
American Passenger Air Transport	324, 404, 514
Amphibian, Single Wheel	338
Ancient History from Aloft	242
Army Pilot, Our First	72
Autogiro	336
Autogiro, How It Flies	290
Aviation, Future of	313
Aviation Industry, Groupings in the	58
Aviation Law	340
Aviation's Patron Saint (Will Rogers)	283
Blimp at the Capital	483
Blimp, Commercial Possibilities of	116
Boeing 80-A	73
Charting Alaska from Air	207
Charting Canada from Air	214
Cooling System, New	70
Cowling to Reduce Drag	164
Craft, Convertible	165
Cup Races, Timing	495
De Havilland 66	166
Diesels for Airplanes, Are They Practical	222
Dornier Plane, Do. X	318, 337, 488
Eaglerock "Bullet"	72
Eckener, Granted Patent	460
"Flamingo" Metal Plane	248
Fly, It Is Safe to	36
Flying Clubs, Private	165
Flying, Learning to	336
Fog Flying, Instruction in	528
Giant Airplanes	488
Glider Salutes Monument	483
Gliding in Germany	248
Goldbeater Skins for Airships	435
Handley Page Slot Mechanism	436
Hangar, Huge Dirigible	230
Helicogyre	70
Instrument Board, Flush	71
Learning to Fly	144
Light Aeroplane Contest	157
Light Airplane, Selling the	529
Lights, Private, Certification of	436
Lindbergh, Scientist	477
Lowering Parcels from the Air	336
Moorings Masts, Mobile	338
Motor, First Radial?	483
Motor-Warming Sheds, Eskimo	165
Neon Light for Penetrating Fog	435
Parachute Broadcasting	287
Passenger Air Transport, American	324, 404, 514
Passenger Travel, Future of	529
Pneumatic Tubes at Croyden	340
Runway Canopy	482
Safety on Airlines	504
Seadrome, Armstrong	340
Seaplane, World's Largest, Do. X	318, 337, 488
Seed Planting by Airplane	72
Slots and Interceptors	529
South America, Wings of	46
Spin, Physiological Effects of the	454
Streamline, Ideal	166
Tailspin, Fatal	306
Timing Schneider Race	495
Will Rogers and Aviation	283
Zeppelin Flight, Chemistry Helps	527
Zeppelin's American Home	230
B	
BASE BALL	
Base Ball, "Lively"	310, 435
BIOGRAPHIES AND PORTRAITS	
Abbot, C. G.	199
Berliner, E.	288
Boykin, R. M.	197
Brush, C. F.	205
Campbell, Major L. H., Jr.	197
Eastman, George	375
Eckener, Dr. Hugo	281
Edison, Thomas A.	206, 377
Ford Henry	206, 377
Gilbert, H. F.	74
Heath, Lady Mary	4
Hoffman, A. C.	280
Hutchinson, W. T.	269
Keys, C. M.	223
Knox, Capt. D. W.	279
Laird, Dr. D. A.	4
Lawrance, Charles L.	224
Lindbergh, Col. C. A.	285
Murray, T. E.	365
Osborn, Dr. H. F.	103
Pack, W. N.	101
Parkes, Oscar	373
Puleston, Capt. W. D.	288
Rentschler, F. B.	223
Rogers, Will	285
Russell, Dr. Henry Norris	7
Woolley, C. L.	471
BOATS. See also MERCHANT MARINE	
Arc-Welded Motor Boats	526
Yachts Transported by Outdoor Motor Power	161
BOTANY	
Avocados—Alligator Pears	59
Fungi that Kill	132
Joshua Tree	425
Mushrooms	22
BREWING	
Outland Industry	428
BRIDGES. See ENGINEERING, CIVIL.	
BUILDING CONSTRUCTION	
Beautifying Washington	110
Bricks, Chemistry Helps Make Better	172
Building Stone, Synthetic	89
Concrete, Expansion Effects in	87
Concrete Improved by Soap	88
Office Building of New Era	484
Plaster Laths, Fiber Metal	263
Pneumatic Tubes in Modern Building	484
Skyscrapers Rest on Lead Mattresses	440
Weather, Artificial for Buildings	24, 80
C	
CHEMISTRY	
Acid Crystals	252
Aluminum Chloride Manufacture	438
Automobile Uses 100 Chemicals	350
Belt Dressing, Chemical, Eliminates Static	170
Bentonite Suitable for Lead Pencils	349
Boiler Scale, Organic Substances Reduce	252
Bricks, Chemistry Helps Make Better	172
Caustic Soda Made by Fluorine	261
Chlorine Carrier	348
Citric Acid Manufacture	545
Columbium May Emerge from Museum	77
Concrete, Expansion Effects in	87
Corn Sugar	429
Corrosion-Resistant Metals Made Immune Electrolytically	78
Cottonseed Grading by Analysis	87
Crucible Material, New	547
Dish Washing, Scientific	174
Ethanolamine Soap Has Many Uses	534
Explosives, Improved	254
Ferric Chloride Becomes Cheap Coagulant	546
Fluorine Commercially Produced	261
Furfural Staple Commodity	78
Genius, Seeking	288
Germany's Chemical Industry Expands	77
Leathand and Saltwater Corrosion	77
Lignite Absorbs Sulfur Gases	547
Malt Syrup	546
Nitrogen, Fixed	546
Nitroglycerine Tamed	440
Outland Industry Comes Back	428
Paint Testing Instruments	174
Peroxide Bleaches Cereals	183
Petroleum Products in Insecticides	348
Power from Polar Cold	77
Protective Coating (Rubalt)	260
Radium, High Cost of	440
Resin, Synthetic, Improves Lacquers	530
Rust Base for Paint	545
Silver as Purification Agent	348
Sionon—A Sugar Substitute	348
Soap Dust, Explosive	350
Soap Making	408
Starch	429
"Stuckum" for Stamps	174
Stills, Industrial, Made of Glass	530
Straw, Waste	351
Sulfur in Air Attacks "Wash"	170
Sunflower Seeds as Source of Potash	78
Synthetic Sweet Smells	386
Titanium Pigments	78

"Weighting" Practice, Standardized.....	530
Writing, Age of, Estimating.....	28
Zeppelin Flight, Chemistry Helps.....	527

CIVIL ENGINEERING

See ENGINEERING, CIVIL.

CLOTHING

Clean Iron Workers.....	477
Clothes Make Men Hot.....	205
What is Wrong With Men's.....	128

COMMERCIAL PROPERTY NEWS

92, 188, 267, 364, 460, 552	
Fish Balls and Fish Cakes.....	269
Inter-Industry Distribution.....	268

COPYRIGHT

Misplaced Copyright Notice Void.....	553
Photograph, Copyright for.....	554
Sleepy Copyright Owners.....	92

CRIME

Banditry by Mail.....	54
Burglar, Foiling the.....	50, 148, 226

CURRENT BULLETIN BRIEFS

80, 178, 250, 352, 446, 538	
-----------------------------	--

D

DAMS. See ENGINEERING, CIVIL.

DIRIGIBLES. See AVIATION.

DRAMA

Stage Goes to School.....	40
---------------------------	----

E

EARTH

Power from the.....	422
Earth Shine.....	30

EDUCATION

Street Car, Educational.....	527
------------------------------	-----

ELECTRICITY

Arc Light Carbons.....	87
Arc-Welded Motor Boats.....	526
Book Carrier, Mechanical.....	402
Cotton Imperiled by Static Electricity.....	247
Edison and his Work.....	377
Electroplating, Thickness of.....	516
Elevator, Electric, for Bananas.....	207
Fig Packing, Electric Heat in.....	65
Flashing Warning Lamp.....	246
Foot Warmer, Electric.....	62
Heat, Portable.....	434
Highway Safety Illumination.....	444
Ice by Wire.....	390
Incense Burner, Electric.....	63
Lamp Factory, Edison's First.....	206
Light Use One Third of Electricity.....	527
Lightning, Photography of.....	27
Metal Mine Electrified.....	501
Metal Pouring Device.....	163
Oil, New for Old.....	183
Photoelectric Comparator.....	366
Portable Heat.....	434
Refrigerators, Manufacture of.....	390
Searchlights for Fire Fighters.....	111
Shock-proof X-Ray Apparatus.....	344
Solderless Wire Connector.....	433
Steam Power Plants Come Back.....	234
Telephone on Train.....	111
Time Siren.....	207
Transformers, Nitrogen Gas for.....	88
U-V Ray Effect.....	482

ENGINEERING, CIVIL

Blasting, Sand Bags for.....	435
Boulevard on Shifting Sands.....	510
Bridge, Grand Canyon.....	111
Bridge, Spiral Approach to.....	527
Crane, Mobile.....	14
Dam, O'Shaughnessy.....	122
Dam, World's Highest, for Irrigation.....	39
Esthetic Engineering.....	510
Hangar, Huge Dirigible.....	230
Ice Aids in.....	161
Regrade Engineering.....	431
Roads, Colombian.....	8
Roads, Steel Framework for.....	78
Roads, Ugly.....	381
Steel Scaffolding.....	385
Roosevelt Highway.....	287
Wires and Cables for Hudson River Bridge.....	518

ENGINEERING, MECHANICAL

Boiler Scale, Organic Substances Reduce.....	252
Bolt and Nut Thread, Self-Locking.....	432
Cars, Railway, Cleaning.....	389
Crane, Mobile.....	14
Locomotive, America's First.....	247
Locomotive, Gas Firing.....	66
Locomotives, Ten Thousand Miles of.....	163

Lumber Plugging Machine.....	53
Mechanical Movements.....	364
Mechanical Wonderland.....	364
Pipe Lines.....	43
Portable Heat.....	434
Power from the Earth.....	422
Railroad Cars, Disinfecting.....	206
Steam Stages a Come-Back.....	234
Train-Carrying Ship.....	21
Vibration for Boat Propulsion.....	56
Water Pipes, Frozen, Prevention.....	432

ETHNOLOGY. See ARCHEOLOGY.

EXPLOSIVES

Improved.....	254
---------------	-----

F

FINE ARTS

Beautifying Washington.....	110
Dossena at Work.....	334
Egyptian Motives for Furniture.....	334
Stone Carving by Sand Blasting.....	342
Washington, the Greater.....	330

FIRE FIGHTING

Carbon Dioxide Gas Used to Fight Fire.....	534
Fire Alarm Senders Photographed.....	207
Forrest Fire Lookout.....	526
Railway Snow-shed Fires.....	524

FISHERIES

Fish Fussy about Salt.....	534
Golf Ball Murders Fish.....	543
Sardine Packing.....	419

FLYING. See AVIATION.

FOODS

Alligator Pears—Avocados.....	59
Botulism and Home Canning.....	74
Candy Mints.....	521
Cereals Bleached by Peroxide.....	183
Corn-cobs Yield New Sweet.....	68
Dining-Car Staff Goes to School.....	513
Fig Packing, Electric Heat in.....	64
Licorice the Versatile.....	208
Mushrooms.....	22
Queer Foods.....	206
Reindeer as a Source of Food.....	104
Sardine Packing.....	419
Sionon—A Sugar Substitute.....	348
Vineyard, World's Largest.....	240

FORESTRY

Forest Fire Lookout.....	526
Joshua Tree.....	425
Lumber Plugging.....	53
Praying Trees of the Desert.....	425
Reforestation.....	13
Tractors Drag Logs.....	247
Weighing Moisture of Lumber in Kilns.....	433

FOSSILS. See GEOLOGY.

FUELS

Anthracite Chokes Rivers.....	160
Gasoline and Alcohol Mixture.....	438
Hydrogenation in Gasoline Production.....	252
Metaldehyde as Fuel.....	88
Oat Hulls for Fuel.....	67
Oil Gusher, Why Does it Gush?.....	212
Petroleum, What Is.....	170
Pipe Lines for Oil and Gas.....	43
Powdered Fuels for Engines.....	530

G

GASOLINE. See FUELS.

GEOLOGY

Dinosaur Leg Bone.....	15
Fossil Reptiles.....	115
Mammoth's Tooth.....	524
Meteor, Large, Falls.....	323
Meteors.....	316
Oil Gusher, Why Does it Gush?.....	212
Power from the Earth.....	422
Seismology, Amateur.....	411

GOLF. See SPORTS.

GLIDERS. See AVIATION.

H

HOUSEHOLD ARTICLES

Foot Warmer, Electric.....	62
Incense Burner, Electric.....	63
Lamp and Globe.....	63
Roaster, Three Piece.....	63
Steel Wool Polisher.....	62

I

IRRIGATION

Aid to.....	162
Dam, World's Highest for Irrigation.....	39

L

LEATHER

Reptile Leather Industry.....	420
-------------------------------	-----

LIBRARIES

Mechanical Book Carrier.....	402
Study Rooms.....	403

LICORICE

.....	208
-------	-----

LIGHT

Edison's First Electric.....	378
Light Holds Universal Speed Record.....	414
Symphonies in Light.....	264
Weighing with Light.....	416

LOCKS AND KEYS

Burglar, Foiling the.....	50, 148, 226
Locks, Time and Combination.....	226

LOCOMOTIVES

See ENGINEERING, MECHANICAL.

M

MARINE EQUIPMENT. See SAFETY.

MECHANICAL ENGINEERING. See ENGINEERING, MECHANICAL.

MECHANICS. See ENGINEERING, MECHANICAL.

MEDICINE

Anemia, Dried Hog Stomach for.....	525
Arsenical Poisoning.....	536
Asthma, Reflex Itching in.....	85
Backache in Golf and Polo.....	168
Baldness, Nervous.....	537
Bathing Accidents.....	346
Blindness Caused by Battery Fluid.....	85
Botulism and Home Canning.....	74
Carbon Monoxide Deaths.....	537
Chemical Burns.....	89
Cockroaches, Damages for.....	76
Compressed Air in Novel Hospital.....	244
Constitution and Reproduction.....	167
Digestion, Effects of Emotion on.....	86
Digestion of Meat.....	75
Drug Store, Modern.....	13
Ethylene, Dangers of.....	250
Eye Examination of Children.....	536
Fish Tapeworm Infestation.....	167
Food, Sensitivity to.....	250
Garage Deaths.....	537
Health and Happiness.....	12
Heart Disease, Conquering of.....	74
Heart Rate During Sleep.....	346
Infants, Body Builds of.....	76
Iodine Surveys.....	442
Licorice the Versatile.....	208
Medicine Chest, Everything for the.....	532
Mental Excitement and Brain Stimulation.....	75
Mongolians, Slanting Eyes of.....	86
Mosquitoes and Horses.....	74
Motorists, Sudden Death of.....	74
Muscle, Machinery of.....	18
Radioactive Waters.....	442
Radioactivity After Death.....	75
Railroad Cars, Disinfecting.....	206
Refrigeration Gases, Poisonous.....	381
Respiration, Artificial.....	64
Respiration, Mechanical.....	524
Ringworm of the Feet.....	442, 536
Shoes for the Baby.....	168
Shoes, Right and Wrong.....	444
Smoke Encourages Pneumonia.....	260
Snake Bite.....	199
Spectacles, Fraudulent.....	289
Sulfur Dioxide Hazard Exaggerated.....	78
Tobacco Smoking.....	442
Tularemia from Muskrat.....	85
Tularemia in Russia.....	444
Weather and Pain in the Joints.....	250
X-ray Apparatus, Shock-Proof.....	344
X-ray Films, Danger from.....	167
U-V Ray Effect.....	482

MERCHANT MARINE

Bow Rudder.....	206
Bremen.....	229, 293
Cable-laying Ship.....	110
Maritime Law Laxity.....	12
Sea Safety Contest.....	229, 491
Train-Carrying Ship.....	21
Vibration, Propelling Boats by.....	56

METEOROLOGY

Neon Light for Fog Penetration.....	235
Radio Does Not Make Rain.....	247
Weather, Artificial, for Offices.....	24, 80
Weather and Pain in the Joints.....	250

METALLURGY. See MINES AND METALLURGY.

MICROSCOPY

Diatoms.....	112
--------------	-----

MINES AND METALLURGY

Alloy, Heat Resistant.....	440
Aluminum Dust, Burning.....	534
Gold Beating.....	110
Iron Wire Acts Like Nerves.....	358
Konel, New Alloy by Westinghouse.....	432
Metal Mine, Electrified.....	501
Metal Pouring Device.....	163
Metals, Corrosion-Resistant Made Immune Electrolytically.....	78
Nickel Welded With Flux.....	351
Nitrogen Treatment for Case-hardening Steel.....	77
Oxygen Lance for Cutting.....	433
Potash, New Sources of.....	252
Pre-heating in Shop Welding.....	451
Razor Blade Science.....	302
"Spotting" of Electro-plated Metals.....	252
Sulfur Mining.....	181
Tunnel Yields Its Cost in Gold.....	148
Vault Construction.....	349
Zinc, Pure.....	349

MISCELLANEOUS

Ball, "Lively" Base.....	310
Banking by Auto.....	344
Burglar, Foiling the.....	50, 148, 226
Cable-laying Ship.....	110
Candy Mints.....	521
Cigarette Container and Ash Tray.....	246
Cigarettes, Self-Lighting.....	76
Cockroaches, Damages for.....	513
Dining-Car Staff Goes to School.....	13
Drug Store, Modern.....	62
Ear Phone.....	188
Fido, Health Food for.....	207
Gas Smeller in Berlin.....	89
Ice, Imitation for Skating.....	63
Incense Burner.....	110
Liberty Bell, Refracting.....	264
Light, Symphonies in.....	226
Locks, Time and Combination.....	15
Mail Box, Waterproof.....	128
Men's Clothing, What Is Wrong With.....	211
Money, Small Bills.....	86
Mongolians, Slanting Eyes of.....	428
Muscle, Machinery of.....	63
Outlawed Industry.....	111
Pencil-Lighter.....	484
Photographing Books.....	302
Pneumatic Tubes.....	420
Razor Blade Science.....	264
Reptile Leather Industry.....	64
Robot, More About.....	158
Robot, What Is a?.....	444
Shoes for the Baby.....	408
Shops, Right and Wrong.....	40
Soap Making.....	174
Stage Goes to School.....	62
"Stickum" for Stamps.....	207
Telephone Book Rack.....	357
Time Siren.....	121
Ultra-violet Rays for Manuscripts.....	381
Vault Manufacture.....	452
Vineyard, World's Largest.....	15
Wall Street and the Research Laboratory.....	553
Watch, Dustless Wrist.....	28
Water-tight Purse.....	263
Word Writing Machine.....	
Writing, Age of.....	
X-ray Detects Smuggled Diamonds.....	

MONEY

Small U. S. Bills.....	211
------------------------	-----

MOVING PICTURES AND TALKING FILMS

Apparatus for "Talkie" Film.....	206
Cyclorama.....	482
Enlargements from Amateur Movies.....	68
Machine Gun, "Movie".....	140
Shooting Wild Life With a "Movie" Camera.....	207
Sound Proof Cage.....	483
"Talkie" Headphones.....	

N

NATURAL HISTORY

Ant "Cowboys".....	181
Antlers, Old and New.....	147
Bees, Honey, Home of.....	158
Bees "Sweet Tooth" Measured.....	358
Bird's Companionate Marriage.....	160
Camel's Hump.....	137
Goats, Photographing.....	140
Insect Pests.....	124
Loon Poses for Camera.....	152
Man versus the Insect.....	109
Monkey-Shines.....	294
Reindeer.....	105
Sea-worm, Minced, Turns Into Family.....	68
Shooting Wild Life With a "Movie" Camera.....	140
Snake Bite.....	109
Snakes, Truth About.....	134
Zoo, Feeding the.....	131

NAVY. See ARMY AND NAVY.

O

OFFICE APPLIANCES

Cigarette Container and Ash Tray.....	63
---------------------------------------	----

Ear Phone.....

Floor Connections, Electric.....	62
Pencil-Lighter.....	63
Rubber Stamp, Flexible.....	62
Telephone Book Rack.....	62

OIL. See FUELS.

OILS AND LUBRICATION

Oil, New for Old.....	183
-----------------------	-----

P

PATENTS AND TRADEMARKS

Automobile Parts "Just-as-Good".....	267
Capitalism and the Patent System.....	93
Discontinuance Not Abandonment.....	268
Celery, Patent on Improving.....	460
"Doctor B. F. Davis" Trademark.....	92
Dogs, Health Food for.....	188
Drugs, Cut Rate on.....	365
Eckener Granted Patent.....	460
Edison and His Work.....	377
Employer Restrained from Using Patent.....	188
First Patent Petition.....	460
Foreign Rights to Patents and Trademarks.....	92
Geographical Term Allowed in Trademark.....	93
Grape Trademark Held Invalid.....	554
Hutchinson, Patent Examiner.....	269
Infringement, Useless Step in.....	267
Insulating Material Patented.....	554
Inter-American Trademark Bureau.....	92
Inventing, Who Does the?.....	267
Italian Inventions.....	189
Joseph Jenks' Petition.....	460
"Mama" Dolls Patents Infringed.....	460
Mark Refused Registration.....	364
Mechanical Method Claims.....	460
Neon Tube Cleaning, No Infringement.....	552
Patentability of Combination.....	364
Patent Attorney—Friend or Enemy?.....	188
Patent Law Abroad.....	460
Patent Protection Still Effective.....	552
Patents Recently Issued 93, 189, 268, 365, 461, 553.....	
"Penn-Allen" Registered as Trademark.....	461
Potato Chip Degreaser, Protection for.....	461
Rotarians Guard Their Name.....	93
Sleeve Valve Motor Patent.....	267
Torpedo Plane Patent Suit.....	267
Trademark Not Used, Denied.....	365
Trademarks, Joint Use of.....	365
"Walker of Patents".....	188
Wanted, a Genius.....	189
War Claims.....	366
Yeast Patents Awarded on Appeal.....	92

PETROLEUM. See FUELS.

PHONOGRAPHS

Phonograph Speedometer.....	69
-----------------------------	----

PHOTOGRAPHY

See also MOVING PICTURES AND TALKING FILMS.

Ancient History from Aloft.....	242
Charting Alaska from Air.....	207
Charting Canada from Air.....	214
Lightning, Sky Photography for.....	27
Photographic Display, Continuous.....	66
Photographing Books.....	111
Wild Life, Shooting With a "Movie" Camera.....	140

PHYSICS

Marble Sculpture and Ultra-Violet Ray.....	503
Radioactivity After Death.....	75
Speed Record of the Universe.....	414
Ultra-Violet from the Sun.....	416
Weighing With Light.....	110
Weights at Bureau of Standards.....	

PLANETARIUM.....

PORTRAITS. See BIOGRAPHY AND PORTRAITS.

PSYCHOLOGY

Men's Clothing, What Is Wrong With.....	128
Mental Excitement and Brain Stimulation.....	75
Muscle, Machinery of.....	18

R

RADIO. See Also TELEVISION.

Parachute Broadcasting.....	287
Radio Does Not Make Rain.....	247
Radio in 1930.....	498

RAILROADS

Cars, Cleaning.....	206, 389
Car Ferry.....	21
Dining-Car Staff Goes to School.....	513
Locomotive, America's First.....	247
Lounge Cars.....	64
Snow-shed Fire Fighting.....	524

RAYS

Marble Sculpture and Ultra-Violet Ray.....	503
Ultra-Violet Rays and Manuscripts.....	357
X-Ray Detects Smuggled Diamonds.....	263
X-Rays in Industry.....	256

REFRIGERATION

Heat-Makes-Cold Refrigeration Unit.....	245
Ice by Wire (G. E. Refrigerator).....	390

Refrigerator Gases, Poisonous.....	381
Sulfur Dioxide Hazard.....	78

ROADS

Colombian.....	8
San Francisco Boulevard Built on Sand.....	510
Steel Framework for Paving.....	78

ROBOT, What Is a?.....	64, 264
------------------------	---------

RUBBER

Protective Coating.....	260
Synthetic Rubber.....	342

S

SAFETY

Accidents, Fatal.....	477
Bathing Accidents.....	346
Chemical Burns.....	89
Elephants Should Carry Lights.....	109
Ethylene, Dangers of.....	250
Flashing Warning Lamp.....	246
Fly, It Is Safe to.....	36
Gas Smeller in Berlin.....	207
Highway Safety Illumination.....	434
Lifeboat, Every Ship a.....	205
Maritime Law Laxity.....	12
Railroad Cars, Disinfecting.....	206
Respiration, Mechanical.....	524
Sand Spreader, Anti-Skid.....	162
Searchlights for Fire Fighters.....	111
Sea Safety Award.....	491
Sea-Safety Contest.....	229
Steel Scaffolding.....	385
Street Cleaning Trucks, Sanitary Bodies for.....	160
Wing Signals, Rattan.....	14
X-Ray Films, Danger from.....	167

SANITATION

Dust and Dirt, City.....	109
--------------------------	-----

SCIENCE

Evolution, Do Any Scientists Deny It?.....	161
Health and Happiness.....	12
Science, Significance of.....	12
Wall Street and the Research Laboratory.....	381

SEISMOLOGY

Amateur Seismology.....	411
-------------------------	-----

SPORTS

Backache in Golf and Polo.....	168
Ball, The "Lively" Base.....	310, 435
Base Ball, "Lively".....	310, 435
Diving from a Gun.....	15
Golf Ball Murders Fish.....	543
Golf Game, Indoor.....	63
Golf Practice.....	287
Ice, Imitation, for Skating.....	89
Motorists, Thrill-Road for.....	14
Tennis Nets, Tightener.....	62
Trap Which Catches Animals Alive.....	433
Water-tight Purse.....	155
Water Wings, Novel.....	63

T

TALKING PICTURES. See MOVING PICTURES AND TALKING FILMS.

TELESCOPES. See ASTRONOMY.

TELEVISION

Television's Progress.....	487
----------------------------	-----

TEXTILES

Cotton Imperiled by Static Electricity.....	247
---	-----

THEATER

Stage Goes to School.....	40
---------------------------	----

TOOLS

Lumber Plugging Machine.....	53
------------------------------	----

TOYS

Baby Roadster.....	62
--------------------	----

TRADEMARKS. See PATENTS AND TRADEMARKS.

TRAVEL AND EXPLORATION

Africa, South, What the World Owes to.....	119
Cape to Cairo Highway.....	154
Jerusalem, Walking Around.....	60

TREES. See FORESTRY.

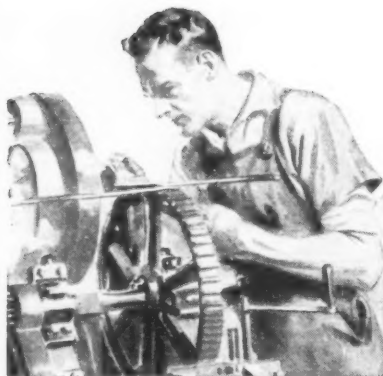
U

ULTRA-VIOLET FROM THE SUN.....	32
--------------------------------	----

W

WASTE

Reclamation of Waste Nets Large Savings.....	67
--	----



He's Patented Four Inventions

AND he's only one of scores of inventors who got their first real start through spare-time study with the International Correspondence Schools.

Jesse G. Vincent, Vice President of the Packard Motor Car Company, inventor of the Packard Twin Six and co-inventor of the Liberty Motor, is a former I. C. S. student.

So is John C. Wahl, inventor of the Wahl Adding Machine and the Eversharp Pencil; W. E. Hallett, inventor of the Hallett Tandem Gas Engine; H. E. Doerr, Chief Mechanical Engineer, Scullin Steel Company, and W. J. Libby, inventor of the Libby Mine Hoist Controller.

Here's the same coupon—the same opportunity that these men had. There's still a chance for you to get ahead if you will only make the start.

One hour after supper each night, spent with the International Correspondence Schools in the quiet of your own home, will prepare you for the position you want in the work you like best.

Yes, it will! Put it up to us to prove it. Without cost or obligation, just mark and mail this coupon.

**Mail this Coupon for
Free Booklet**

INTERNATIONAL CORRESPONDENCE SCHOOLS "The Universal University" Box 6113-B, Scranton, Penna.

Without cost or obligation on my part, please send me a copy of your 48-page booklet, "Who Wins and Why," and tell me how I can qualify for the position, or in the subject, before which I have marked an X:

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|--|---|
| <input type="checkbox"/> Architect | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Architectural Draftsman | <input type="checkbox"/> Aviation Engines |
| <input type="checkbox"/> Building Foreman | <input type="checkbox"/> Plumber and Steam Fitter |
| <input type="checkbox"/> Concrete Builder | <input type="checkbox"/> Plumbing Inspector |
| <input type="checkbox"/> Contractor and Builder | <input type="checkbox"/> Foreman Plumber |
| <input type="checkbox"/> Structural Draftsman | <input type="checkbox"/> Heating and Ventilation |
| <input type="checkbox"/> Structural Engineer | <input type="checkbox"/> Sheet-Metal Worker |
| <input type="checkbox"/> Electrical Engineer | <input type="checkbox"/> Steam Engineer |
| <input type="checkbox"/> Electrical Contractor | <input type="checkbox"/> Marine Engineer |
| <input type="checkbox"/> Electric Wiring | <input type="checkbox"/> Refrigeration Engineer |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> R. R. Positions |
| <input type="checkbox"/> Electric Car Running | <input type="checkbox"/> Highway Engineer |
| <input type="checkbox"/> Telegraph Engineer | <input type="checkbox"/> Chemistry |
| <input type="checkbox"/> Telephone Work | <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Coal Mining Engineer |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Navigation <input type="checkbox"/> Assayer |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Iron and Steel Worker |
| <input type="checkbox"/> Toolmaker | <input type="checkbox"/> Textile Overseer or Supt. |
| <input type="checkbox"/> Patternmaker | <input type="checkbox"/> Cotton Manufacturing |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Woolen Manufacturing |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Agriculture <input type="checkbox"/> Fruit Growing |
| <input type="checkbox"/> Bridge Engineer | <input type="checkbox"/> Poultry Farming |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Mathematics <input type="checkbox"/> Radio |

BUSINESS TRAINING COURSES

- | | |
|--|---|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Business Correspondence |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Show Card and Sign |
| <input type="checkbox"/> Personnel Management | <input type="checkbox"/> Lettering |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Accounting and C. P. A. | <input type="checkbox"/> English |
| <input type="checkbox"/> Coaching | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Mail Carrier |
| <input type="checkbox"/> Secretarial Work | <input type="checkbox"/> Grade School Subjects |
| <input type="checkbox"/> Spanish <input type="checkbox"/> French | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Illustration <input type="checkbox"/> Cartooning |
| <input type="checkbox"/> Advertising | <input type="checkbox"/> Lumber Dealer |

Name.....
Street.....
Address.....
City..... State.....

Occupation.....
If you reside in Canada, send this coupon to the
International Correspondence Schools Canada, Limited,
Montreal, Canada

INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—DECEMBER, 1929

Alexander Aircraft Company.....	543	Marvin Cigar Co.....	547
Allied Radio Corporation.....	548	Masonite Corporation.....	531
American Lead Pencil Company.....	544	Metal Cast Products Company.....	544
American Pipe Bending Machine Company.....	548	Metallic Sign Letter Company.....	544
American Thermo Ware Co.....	546	Milwaukee Die Casting Company.....	539
American Tobacco Company.....	(Fourth Cover)	Wm. Mosey & Sons, Inc.....	543
Francis Bannerman Sons.....	548	Munn & Co.....	543 & 546
Bartlett-Hayward Co.....	537	National Tuberculosis Assn.....	549
Bernard & Heller.....	546	New Method Mfg. Co.....	546
Box 193.....	516	C. A. Olson.....	548
Broderick & Bascom Rope Company.....	541	Pacific Technical University.....	547
Chicago Gear Works.....	548	Packard Motor Car Company.....	(Third Cover)
Chicago Technical College.....	547	Review of Reviews Company.....	535
Crescent Tool Company.....	546	Roat & Lohman.....	542 & 546
Delta Specialty Company.....	533	Ruxton Multi-Vider Corp.....	542
Dodge Brothers Trucks.....	(Second Cover)	Schwerdtle Stamp Co.....	547
Du Maurier Company.....	548	Science News-Letter.....	544
Edwin Cigar Co.....	544	Charles A. Scott.....	546
Elec. Service & Eng. Bureau (P. O. Box 132).....	546	Signal Electric Mfg. Company.....	547
Florsheim Shoe Co.....	543	S. K. F. Industries, Inc.....	465
Forbes Publishing Company.....	468	Stephenson Laboratory.....	547
Ford Motor Company (Aviation).....	470	Timken Roller Bearing Company.....	466
French Electric Co., Inc.....	546	Unisol Mfg. Company.....	542
Gillette Safety Razor Company.....	(Color Insert)	Veeder-Root, Inc.....	555
Gilson Slide Rule Company.....	544	H. von Schon.....	548
International Correspondence Schools.....	560	Westinghouse Electric & Mfg. Co.....	(Insert)
International Typewriter Exchange.....	548	Wollensak Optical Co.....	548
Keasbey & Mattison.....	544	Henry Zuhr, Inc.....	546
Otto Konigslow Mfg. Company.....	546		
Laboratory Materials Company.....	544		
E. Leitz, Inc.....	545		

FRANCIS N. PRUYN,
Advertising Manager

Western Advertising Representative
Blanchard-Nichols-Coleman
Chicago, Los Angeles, San Francisco,
Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President
JOHN P. DAVIS, Treasurer

LOUIS S. TREADWELL, Vice-President
I. SHELDON TILNEY, Secretary

EDITORIAL STAFF

ORSON D. MUNN, Editor

ALBERT A. HOPKINS

ALBERT G. INGALLS

LOUIS S. TREADWELL

A. P. PECK

F. D. MCHUGH

HENRY W. HOUGH

PROFESSOR HENRY NORRIS RUSSELL

PROFESSOR ALEXANDER KLEMIN

CORRESPONDING EDITORS

ERNEST W. BROWN, Sterling Professor of Mathematics, Yale University.

M. LUCKIESH, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company, Nela Park, Cleveland.

A. E. BUCHANAN, Jr., Lehigh University, Assistant Secretary of the American Institute of Chemical Engineering.

D. T. MACDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

MORRIS FISHBEIN, M.D., Editor of the *Journal of the American Medical Association* and of *Hygieia*.

ROY W. MINER, American Museum of Natural History.

WILLIAM K. GREGORY, Professor of Vertebrate Paleontology, Columbia University.

RUSSELL W. PORTER, Optical Associate, Jones and Lamson Machine Company, Associate in Optics and Instrument Design, California Institute of Technology.

LEON A. HAUSMAN, Professor of Zoology, New Jersey College for Women.

DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research.

PAUL R. HEYL, Physicist, United States Bureau of Standards.

W. D. PULESTON, Captain, United States Navy—Technical Adviser on Military Matters.

DAVID STARR JORDAN, Chancellor Emeritus, Leland Stanford Jr. University.

ELIHU THOMSON, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

WALDEMAR KAEMPFERT, Director Museum of Science and Industry, Chicago.

R. W. WOOD, Professor of Experimental Physics, Johns Hopkins University.

Vol. 141, No. 6. Price 35 cents a copy. \$4.00 a year. Postage prepaid in United States and possessions and foreign countries where eighth zone rates apply. Other foreign countries \$5.00 a year, postage prepaid. Canada \$4.50 a year postage prepaid. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

547
531
544
544
539
543
546549
546
548547
(over)535
546
542547
544
546
547
465
547466
542555
548548
546

LUXURIOUS TRANSPORTATION

The magnificently carved and gilded barges in which Georgian royalty traversed the Thames, represented the height of 18th century luxury



THE new series Packard cars now on display again impress the permanence and stability of the famous Packard design.

Refined and beautified as they are, these new cars remain unmistakably Packard. No way has yet been found to improve the fundamental grace of the distinctive and characteristic Packard lines.

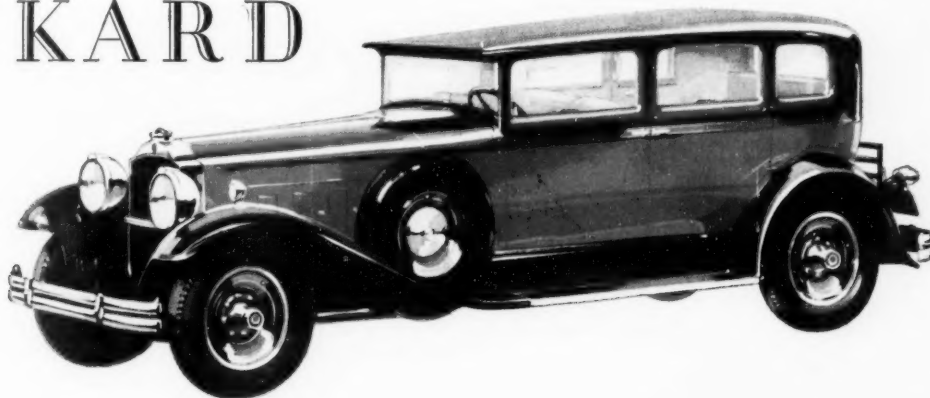
And this freshly emphasized stability of appearance continues to impress a motor car buying public tired of investing, every other year, in a car which will be out of date and outmoded a year later.

The permanent style and beauty of the Packard Eight means more even than the satisfaction of owning a car acclaimed as the most beautiful in the world.

It has its certain reflection upon the owner's pocketbook. For the finest of materials and workmanship are discounted if beauty and style do not long persist.

The Packard owner enjoys keeping his car far longer than is usual—for the Packard continues to provide luxurious transportation—and to look the part.

PACKARD



A S K T H E M A N W H O O W N S O N E

AN ANCIENT PREJUDICE HAS BEEN REMOVED

Never again need scientific research grope in darkened cellars behind doors bolted against torture. AMERICAN INTELLIGENCE has swept before it the ignorant barrier which stupidly impeded men of genius and science marches proudly on.



"TOASTING DID IT"—

Gone is that ancient prejudice against cigarettes —Progress has been made. We removed the prejudice against cigarettes when we removed from the tobaccos harmful corrosive ACRIDS (pungent irritants) present in cigarettes manufactured in the old-fashioned way. Thus "TOASTING" has destroyed that ancient prejudice against cigarette smoking by men and by women.

"It's toasted"

No Throat Irritation—No Cough.

